25/13

ADMINISTRATION REPORTS

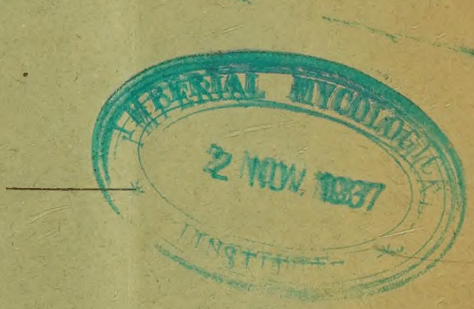
OF THE

AGRICULTURAL CHEMIST, ENTOMOLOGIST, AND MYCOLOGIST

OF THE

DEPARTMENT OF AGRICULTURE, MADRAS, FOR 1936-37

(DETAILED REPORT)



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DETAILED SCIENTIFIC REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST FOR THE YEAR 1936–37.

I was in charge of the section throughout the year and was confirmed in my appointment with effect from 14th August 1935.

2. The different branches of the section were under the control of gazetted officers as below :—

(i) Analytical and Advisory.	M.R.Ry. T. S. Ramasubrahmanya Ayyar Avargal.
(ii) Physical Chemistry ...	Government Agricultural Chemist.
(iii) Animal Nutrition ...	Government Agricultural Chemist.
(iv) Microbiology	M.R.Ry. P. D. Karunakar Avargal.
(v) Sugarcane and Jaggery.	M.R.Ry. G. Ganapathi Ayyar Avargal.
(vi) Soil Surveys	M.R.Ry. C. V. Ramaswami Ayyar Avargal.
(vii) Malting of cholam ...	M.R.Ry. M. Suryanarayana Garu.

The Physical Chemistry and Nutrition branches were under my personal and immediate control.

3. The work of the section is reported on, under the two subheads, (I) General—including analytical and routine advisory work and (II) Research in soil science, soil surveys, plant and animal nutrition, microbiology and agricultural industries.

I. GENERAL.

4. *Meteorology.*—Records were maintained of weather conditions with a daily record of climatological conditions as at 8·00 hours. A monthly weather review was compiled from reports received from Agricultural Research Stations and from extracts from the Indian Daily Weather Reports published at Poona. This weather review was published monthly in the Madras Agricultural Journal.

Table below gives a summary of observations recorded at Coimbatore for the year 1936–37.

Table I.

Annual weather report, 1936–37.

Month and year.	Temperature° F				Wind velocity.	
	Absolute maximum.	Absolute minimum.	Mean maximum.	Mean minimum.	Mean daily wind velocity at 8 hours M.P.H.	Miles per hour for past 24 hours.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1936—						
April	100·5	66·5	95·5	72·8	0·3	1·3
May	102·0	71·8	98·7	74·8	1·0	2·2
June	92·0	70·3	85·4	71·6	6·3	6·3
July	90·5	68·3	86·1	71·1	6·5	5·6
August ..	90·0	66·5	85·8	71·2	5·5	5·3
September ..	93·3	66·8	89·9	71·2	1·8	2·7
October ..	92·0	67·0	87·7	70·5	0·9	1·4
November ..	87·0	60·0	83·9	69·0	1·4	1·2
December ..	88·2	59·6	84·6	66·8	2·2	1·5
1937—						
January ..	90·5	57·8	86·0	64·0	1·8	1·5
February ..	93·7	62·5	91·2	68·2	1·7	1·2
March	96·5	64·0	94·1	70·8	0·5	1·1

Month and year.	Humidity per cent.	Rainfall—inches.				
		Total for the month.	Mean for the month (average of previous ten years).	Departure from normal.	Heaviest fall in 24 hours.	Number of rainy days.
	(8)	(9)	(10)	(11)	(12)	(13)
1936—						
April	69·2	0·81	2·45	— 1·64	0·65	2
May	71·4	2·04	3·06	— 1·02	0·83	3
June	70·4	1·46	1·23	+ 0·23	0·52	4
July	72·1	1·95	1·15	+ 0·80	0·66	5
August ..	73·9	1·93	1·19	+ 0·74	1·25	4
September ..	75·5	0·94	1·89	— 0·95	0·26	3
October ..	79·2	3·51	6·27	— 2·76	0·98	10
November ..	84·0	4·43	4·07	+ 0·36	1·33	8
December ..	76·0	0·33	1·70	— 1·37	0·30	1
1937—						
January ..	72·8	0·03	0·48	— 0·45	0·03	Nil.
February ..	75·5	0·09	0·41	— 0·32	0·04	Nil.
March	70·2	2·00	0·39	+ 0·61	1·41	3

	INCHES.		INCHES.
Annual rainfall	19·52	Annual average..	24·29
Departure from normal ..	— 4·77	Number of rainy days	43

Rainfall was below normal, it being in large defect in the month of October. The rainfall of the south-west monsoon period was slightly above normal, while that of the north-east monsoon period was below normal.

5. *Analytical and Advisory.*—Statement below gives details of the samples analysed during the year. It does not include samples analysed in connexion with original investigations and 223 samples of soil collected and analysed in the course of the conduct of the Cauvery-Mettur Soil Survey.

TABLE II.

Particulars.	Research.	Agricultural department.	Other Government departments.	Ryots and other private parties.	United Planters' Association of South India.	Total.
1 Soils	89	166	25	9	2	291
2 Manures	18	38	..	18	8	82
3 Waters	8	1	6	2	..	17
4 Foods and Feeds ..	..	74	99	3	..	176
5 Cane juices ..	..	1,113	4	..	..	1,117
6 Field experiments.	24	..	..	..	..	24
7 Miscellaneous ..	38	117	..	2	..	157
Total for 1936–37 ..	177	1,509	134	34	10	1,864
Total for 1935–36 ..	258	853	140	12	26	1,289
Total for 1934–35 ..	570	571	147	15	16	1,319

All the samples of manure received from the United Planters Association of South India were accompanied by guarantees of analysis and were found to agree with the guarantee in their Nitrogen and Phosphoric acid contents, but were invariably below guarantee in their potash contents.

A total of Rs. 579–8–0 was collected as analytical fees against Rs. 619 in 1935–36 and Rs. 262–8–0 in 1934–35.

As was usual in previous years the section in addition to analysis and reports of a routine nature, had to deal with numerous requests for advice on questions connected with the chemistry of soils, manures, cattlefeeds, and human foods from officers of the department in connexion with their work, and other Government departments, i.e., Industries, Jail, Public Health and Medical.

A number of samples of interest were analysed and reported on, the following gives a summary of details of such samples of interest :—

(i) In the district of South Kanara, there is available a variety of fish called Kollateru locally (English—White bait : Scientific name E. Commersonianus) which is reported to be largely used for conversion into manure for manuring sugarcanes in the area, by the Deputy Director of Agriculture, VII Circle, Tellicherry; on analysis it was found to contain a high percentage of Nitrogen.

	Laboratory number 1034/35–36.
	PER CENT.
Moisture	12·19
Loss on ignition	70 37
Insoluble mineral matter	0·28
Soluble mineral matter (by difference) ..	17·16
Total ..	100·00
Nitrogen (N)	10·40
Phosphoric acid ($P_2 O_5$)	4·37

(ii) The South Indian Manuring and Tanning Works at Samalkot have opened a bone mill to crush bones for export purposes. A sample of bone meal produced in their mills was analysed with the following results :—

	Laboratory number 1138/35–36.
	PER CENT.
Moisture	8·08
Loss on ignition	32·94
Insoluble mineral matter	5·5
Soluble ,, ,, ...	53·48
Total ..	100·00
Nitrogen (N)	4·93
Phosphoric acid ($P_2 O_5$)	21·92

The bone meal was a fairly good sample. It is advisable that the firm is discouraged from trying to export this useful commodity to continental markets, as this will adversely affect the agriculture in this country.

(iii) From the Agricultural Research Station, Samalkot, two samples of hay prepared from Pillipesara and Sunnhemp were analysed. Both the samples were good samples of legume fodder, but the one obtained from Sunnhemp was rather high in Crude Fibre. Their analyses are given below :—

	Laboratory number 1113/1935–36. Sunnhemp hay.	Laboratory number 1114/1935–36. Pillipesara hay.
	PER CENT.	PER CENT.
Moisture	6·38	6·21
Ash	6·74	12·45
Ether extractives	1·09	1·47
Crude proteids	13·93	17·76
Crude fibre	40·77	25·72
Carbohydrates (by difference) ..	31·09	36·39
Total ..	100·00	100·00
Nutritive ratio	1 : 3.6	1 : 3·2
Albuminoids or true proteins ..	9·31	12·59
Acid value in mg of KOH per gm. of fat or ether extract.	70·9	60·9

(iv) The Cotton Specialist, Agricultural Research Institute, Coimbatore, sent four varieties of Bengalgram, one of which was a Karachi variety which has been reported to be more suitable for the preparation of Porikadalai. These were analysed for their proteids, and starch contents and

their specific gravities were also determined, the results of which are presented below :—

	Str. No. 468	Str. No 482	Grade. 8	Karachi.
Heads of analysis.	—	—	—	—
Laboratory No. 36-37 ..	161	162	163	164
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Proteids	28·56	27·63	27·81	24·00
Starch	44·20	40·20	40·20	41·4
Specific gravities ..	1·327	1·329	1·307	1·279
Ratio of N to starch.	1 : 9·6	1 : 9·1	1 : 9·0	1 : 10·8

The wide ratio of Nitrogen to starch in the Karachi, it was considered, might be a factor in determining its best suitability for the preparation of Porikadalai and the other possible factor may be found in the fact of the Karachi variety having the lowest specific gravity. This may have a relationship to the air space between seed coat and the cotyledons in the grain. If it is so, the lower the specific gravity, the greater will be this air space, which naturally must influence the better popping quality of the Karachi variety.

(v) From the Millets Specialist, Agricultural Research Institute, Coimbatore, ten samples of cholam one of which was popped were analysed to see how the popped varied from the original grain. These were analysed for their food and mineral values and, also for their sugar and starch contents. No difference could be noticed in their chemical composition as would be evident from the following table :—

	Expressed on dry basis.	
	Popped Laboratory number 115/36-37.	Ordinary Laboratory number 116/36-37.
	PER CENT.	PER CENT.
Ash	1·70	1·55
Crude proteins	11·83	11·45
Ether extractives	4·37	4·05
Crude fibre	1·58	1·83
Carbohydrates (by differences)	80·56	81·12
Total ..	100·00	100·00
Albuminoids or true proteins ..	11·54	11·34

	Expressed on dry basis.	
	Popped Laboratory number 115/36-37.	Ordinary Laboratory number 116/36-37.
	PER CENT.	PER CENT.
Ash had the following composition—		
Lime (CaO)	0·24	0·20
Magnesia (MgO) ..	0·61	0·28
Potash (K_2O)	0·33	0·37
Phosphoric acid (P_2O_5) ..	0·84	0·81
Nitrogen (N)	1·89	1·84
Sugars in aqueous extract—		
Sucrose	0·62	0·71
Reducing sugars	0·51	0·56
Starch	61·45	63·20

It is likely that, during popping, the starch undergoes certain amount of dextrination, thus making it more easily digestible.

(vi) The Deputy Director of Agriculture, VIII Circle, Coimbatore, sent a sample of earth from an old fort site, Nanjaipuliampatti, Gobichettipalaiyam taluk, a mound on the bank of the Bhavani. It is reported that this earth is being used for manuring paddy lands. On analysis it was found to contain the following composition :—

	Laboratory number 237/36-37.
	PER CENT.
Nitrogen (N)	0·12
Potash (K_2O)	1·50
Phosphoric acid (P_2O_5)	2·22
Soluble salts	0·587
pH	8·5

This earth is rather rich in its essential plant food materials, especially in its potash and phosphoric acid contents. It will prove useful for paddy crop if supplemented with bulky organic manure to improve the low organic matter it contains. Although pH. of the soil is 8·5 and the total soluble salts are present as much as 0·59 per cent, these will not interfere where the crop concerned is paddy, if only precautions are taken to apply this manurial earth over a previous green manure application.

(vii) The Commissioner, Karur Municipality, sent a sample of poudrette prepared by the municipality from the habitation wastes, under the guidance of the local demonstrator.

It analysed as follows :—

	Laboratory number 623/36—37.
	PER CENT.
Moisture	4·64
Loss on ignition	62·18
Insoluble mineral matter	67·39
Soluble mineral matter	15·79
Total ..	100·00
Nitrogen (N)	0·65
Potash (K_2O)	1·04
Phosphoric acid (P_2O_5)	1·07
Humus (soluble in 4 per cent Ammonia) ..	2·88

This is a fairly good sample of poudrette and the Karur Municipality has to be congratulated in having so successfully prepared this useful manurial product from their town wastes.

(viii) The South Indian Trading Company, Limited, Tiruppur sent a sample of cattle food prepared by them for the market, calling it by the name "Cattle Nectar." They would not reveal the actual ingredients used in its make-up, but it was reliably understood from a talk with the agent who brought the material for analysis, that all kinds of materials, about 35 in number, were used, chief of them being cotton seed, groundnut cake and gingelly cake; all kinds of cereals, pulses and brans were used in small quantities; a little of bone meal, fish meal and salt were also used; and a small quantity of Fenugreek appeared to have also been added to give the product an agreeable smell. They have priced it at 14 annas per maund of 25 lb. From an idea of its chemical composition given below, a maund of this food must be sufficient for a milch cow yielding about 9 to 10 lb. of milk a day, for a period of four or five days besides straw; for a bullock doing normal routine work, this quantity will come up to seven or eight days besides straw.

Analysis.

	Laboratory number 36—37.
	PER CENT.
Moisture	8·72
Ash	15 07
Crude proteins	23·82
Ether extractives	5·91
Crude fibre	11·97
Carbohydrates (by difference)	34·51
Total ..	100·00
Albuminoids	20·88
Lime	3·67
Potash	1 18
Phosphoric acid	3·12
Nutrition Ratio	1 : 2·3
Acid value in terms of m.g. KoH per gm. of fat or ether extract	105·3

Considered from a practical and economical point of view, it may be recommended, provided the free fatty acids content of the oil as revealed by the acidity is lessened by avoiding the use of stale concentrates in compounding the cake : otherwise it compares favourably with cotton seed in its feeding value. The quantities of nutrients present are well balanced.

It was considered that the quality of this compound concentrate would be considerably improved if groundnut cake was included in larger quantities.

(ix) A sample of pillipesara seed was analysed for the Superintendent, Central Farm, Coimbatore, and was found to prove good as a cattle food, as will be evident from the following analysis :—

	Laboratory number 519/36—37
	PER CENT.
Moisture	9·55
Ash	3·56
Crude protein	20·03
Ether Extractives	0·91
Crude fibre	0·96
Carbohydrates (by difference)	64·99
Total ..	100·00
Albuminoids	19·07
Lime	0·24
Magnesia	0·35
Potash	1·69
Phosphoric acid	0·98

(x) Four samples of composts prepared at the Central Farm, Coimbatore, using activated sludge and farm yard manure as starters have analysed as follows :—

Laboratory number 1936-37.	453	454	455	456
Details of sample and starter.	Cane trash compost. Activated sludge.	Vegetable Farmyard manure.	Cane trash Farmyard manure.	Cumbu straw. Activated sludge.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	56·4	43·95	61·95	55·69
Loss on ignition ..	16.74	13·36	17·16	16·43
Nitrogen (N)	0·35	0·66	0·37	0·61
Potash (K_2O)	0.46	0·88	0·42	0·82
Phosphoric acid (P_2O_5).	0·24	0·36	0·17	0·31
Humus (soluble in 4 per cent Ammonia) ..	4·52	4·39	4·32	4·91

It will be seen that all the four samples are only average samples and that the activated sludge does not appear to have produced a better product when used as a starter in comparison to farm yard manure as starters.

(xi) Hajee K. A. Bawa, the enthusiastic proprietor of the Canara Manure Works, Mangalore, sent a sample of Marotti cake for ascertaining its composition. On analysis it was found to compare favourably only with Punnai cake (Calophyllum Inophyllum). For a cake sample, the nitrogen content was rather low being within 3 per cent.

	Laboratory number 626/36-37.
	PER CENT.
Moisture	9·08
Loss on ignition	84·40
Insoluble mineral matter	0·92
Soluble mineral matter	5·60
	100·00
Nitrogen (N)	2·87
Phosphoric acid (P_2O_5)	1·10

(xii) At the instance of the Superintendent, Central Farm, Coimbatore, a sample of sweet potato vine was analysed

for its food value and found to contain a fair nutritive value as will be seen from its analysis below :—

	Laboratory number 624/36—37.
	PER CENT.
Moisture	86·42
Ash	2·98
Crude proteins	2·58
Ether extractives	0·32
Crude fibre	3·05
Carbohydrates (by difference)	4·65
Total ..	100·00
Nutritive ratio	1·43
Albuminoids	1·97
Iron	0·12
Alumina	0·22
Lime	0·27
Magnesia	0·20
Potash	0·52
Phosphoric acid	0·15
Nitrogen	0·41

This can form a very useful cattle food.

II. RESEARCH.

6. *Soil Surveys of Irrigation Projects.*—At the instance of the Irrigation Department, soil surveys were carried out of two project areas, i.e., the Cauvery-Mettur Project and the Gundlakamma Project area. The Kattalai High Level Channel command was visited, to examine the canes which have led to the development of alkalinity in certain areas.

7. *Cauvery-Mettur Project Area.*—A soil survey of the Cauvery-Mettur Project area in the Tanjore district covering the taluks of Tanjore, Mannargudi, Pattukkottai and Papanasam was carried out to study the soils of the commanded area and to assess their suitability for crops as alternative to paddy, now that these areas have come under new irrigation. This area is known as the new delta of Tanjore as against the old delta which has been under irrigation for a long time.

The main conclusions of these investigations may be stated as follows :—

(i) The soils of the project area fall into two main groups, (1) the old and (2) the wet land soils. The latter group is composed of soils some of which have been brought under irrigation recently, others awaiting conversion to wet. The new wet shows some textural and slight profile diversities on the basis of which they have been further classified into

red, red loam, light loam and black soils. The delta soil has been grouped separately and studied for the sake of comparison.

(ii) Over 95 per cent of the area belongs to the laterite group of soils, the rest being black soils.

(iii) The mechanical composition of these soils is seemingly sandy loam to loam, but other factors such as reaction and chemical composition completely modify their general behaviour in nature.

(iv) The moisture retaining power is extremely erratic not in agreement with the mechanical composition, but generally extremely low with the exception of the black soil. The hygroscopic co-efficient is also low.

(v) The content of soluble salts in the new wet land soil is remarkably low but the occurrence of a high water table may likely interfere with drainage and crop growth. Amongst the old wet land group there are localised zones of salt concentration.

(vi) The absence of soluble salts, the acid reaction of the soil with a preponderance of sesquioxides bring about the deflocculation of the soil in the profile. This layer functions as an impermeable zone and is popularly termed as " elai."

(vii) The exchange capacity of the soil is low and the soils are, in general, base unsaturated which is in agreement with the observed reaction of the soil. The absence of lime with a high concentration of sesquioxides in the clay complex is a noticeable feature of these soils.

(viii) The soils are poorly supplied with the essential plant foods and the urgency of supplying these is strongly indicated.

(ix) The silica-sesquioxide ratio, the presence of free alumina (hydrated), the reaction of the profile and the characteristic profile features place the soils under " laterites." Other evidences, geological and chemical, lead to their special classification as " detrital " laterites.

(x) The base unsaturated condition of these soils impress the necessity for a liberal application of lime to remedy the defects noticed, as suggested by the lime requirements studies.

(xi) The black and delta soils possess conditions favourable for crop growth, although the plant food requirements have to be made good to meet the needs of crops.

(xii) The survey of the results of the determinations carried out on these soils stress the immediate necessity for a general amelioration of the soils, through a systematic programme of application of green manures and also the simultaneous use of lime and phosphates to improve the retentivity of soils for moisture and their fertility.

(xiii) Although the adoption of the above suggestions would improve the soil and the sub-soil drainage as well as impede the formation of the " elai " layer, yet it is imperative that attempts must be directed to encourage natural drainage of the country.

(xiv) In areas favourably situated where water could be had throughout the year more remunerative crops like sugarcane could be introduced. Availability of water is the only limiting factor. Old wet lands which are too alkaline are only suitable for paddy. In other areas, without an all round improvement of the soil, the scheme of introduction of alternative crops cannot be undertaken with prospects of great success.

The detailed report is being submitted separately.

8. *Gundlakamma Project Soil Survey.*—The project command lies in the Ongole taluk of the Guntur district, beginning at Kotikalapudi near Addanki and extending southwards to the main river and on the east to the coast.

(i) The object of the soil survey was to determine whether the soils of the commanded area are suitable for wet cultivation. Special staff was sanctioned at the end of the year and field work was started in March and is in progress.

(ii) A preliminary traverse of the area was made before deciding on the soil survey and it was seen that the greater part of the area was composed of black soils, of alluvial origin and growing good crops whenever water was available for irrigation. The tail-end of the command had saline areas on which nothing would grow.

(iii) Work is in progress.

9. *Kattalai High Level channel command.*—The command of the Kattalai High Level channel in Kulitalai taluk of Trichinopoly district was visited at the instance of the Irrigation Development Board. It was reported that large areas had become saline on the opening of the new channel and that plant growth was inhibited. A preliminary inspection showed that saline areas were found in parts of the command, not directly as a result of the supply of water, but owing to a rise of water table as drainage was not taking place normally. The main drainage of both the old south bank channel and the new high level canal was a hill stream known as the Kulitalai Katuwari which was not functioning owing to its being dammed at several places. This impeded drainage resulted in water logging. Another set of lands were seen to be alkaline to a considerable extent, these lands were new wet lands under reclamation and were formerly date forests. Ameliorative measures were suggested for these lands which had a pH. of 10·0 due to large quantities of sodium carbonate and bicarbonate in the soil. For the water logging it was recommended that the dams across the drainage be removed to stimulate natural drainage.

10. *Investigations on soils*—(i) *Origin of soils.*—Following up the work on the Tungabhadra Soil Survey, an investigation was started in the laboratory on the chemical properties of black and red soils with a view to determine their origin of the two types. It has already been stated that these two types of soils occurring as they do in close juxta-position in the Madras Deccan, and differing in their chemical and physical properties do not have anything common in their origin. The black soils have a SiO_2/R_2O_3 ratio in their clay fraction of 2 and above while the red soils have a ratio of below 2. The silica content in relation to the alumina content is slightly different, and distinguished one from the other. Investigations carried out during the year revealed, that while the black soils contain no Al_2O_3, the laterite soils have a high content and the red soils have a Al_2O_3 content of intermediate value between those of the black and laterites.

A new method of estimation of the Al_2O_3 content was investigated and was found to give concordant results.

This preliminary work has been able to throw light on the problems of origin which seems to be connected very much more with the microbiological composition of the parent rock than with climate or environmental influences during soil formation. Further work is in progress.

(ii) *Electrical conductivity of soils and waters.*—The measurement of the salt content of soils and waters by the Electrical Conductivity method was studied in detail. With soil the Electrical Conductivity is a measure of the salt content, but depends on the salts present in the extent to which they are dissociated. For example the dissociation of calcium and magnesium sulphates are less dissociated than chlorides, and again the dissociation of the salts depends on the concentration of the solution in the soil. A 2·0 per cent solution of NaCl has 1·8 times the conductivity as a similar solution of sulphates. It is thus not always possible to determine the actual concentration of a salt solution by a mere measurement of the conductivity and an application of a factor.

In the case of a sample of water, it is possible to use the conductivity method in the field, using a temperature co-efficient of 2·1 per degree centigrade and a factor of 1·25 for Nacl. to get the actual total solid content of water. This was verified in the analysis of 53 different water samples, the calculated total salt content being very nearly equal to the actual salt content. The electrical conductivity method is thus suitable as a convenient field method in studies on the hydrology of a tract in irrigation researches.

(iii) *Electrical Conductivity and Soil Fertility—(a) In relation to crop yields.*—The seven-day increase in conductivity of several soils of the old and new permanent manurial experimental plots were studied. It was seen that the values obtained had no relation to the crop yields.

(*b*) *In relation to continuous cropping.*—The seven-day increase in conductivity of the soils of the New Permanent Manurial plots taken annually from 1926–36 were studied and showed a progressive decrease. This is in keeping with the work of Sen and Wright at Rothamsted who conclude that fallowing has the effect of raising the seven-day increase in conductivity.

(*c*) *In relation to soil profile.*—The seven-day increase in conductivity of surface and lower horizon of 30 profile pits of the Tungabhadra Soil Survey was determined. It was seen that, in the deeper horizons which have a high salt concentration, the values obtained were small and insignificant, while in the surface layers the values were normal. The low values are probably due more to the high salt concentration than to lessen bacterial activity.

(iv) *Irrigation in relation to black soils.*—Following on the work on the Tungabhadra Soil Survey, work was planned on the effect of irrigation on black soils. The recommendation made in the report on the soil survey was accepted by Government and a Research Station is to be started this year at Siruguppa to deal with this problem. A scheme of work on the chemical part of the problem was drawn up and submitted for approval. A suitable site was selected and building work is in progress.

11. *Field experiments*—(*a*) *Green manure experiments with paddy.*—The following table gives the yield in lb. :—

Treatment.	Yield per acre.	
	Grain.	Straw.
	LB.	LB.
Control no manure	2,955	3,294
2,000 lb. green manure ..	2,987	3,747
4,000 ,, ,, ..	2,790	3,214
6,000 ,, ,, ..	3,095	3,495
8,000 ,, ,, ..	3,123	3,486
10,000 ,, ,, ..	3,155	3,345
12,000 ,, ,, ..	3,098	3,482

It is again seen that the plots which receive 6,000 to 8,000 lb. of green manure application have given the best yields as a residual effect after one year.

(*b*) *Seed-bed manuring experiments.*—A new experiment to elucidate certain points in the beneficial effects of heavily manuring the seed-bed for paddy on the subsequent transplanted crop were started in the 6 blocks of the wet lands. The work this year was of the nature of a standardizing experiment in which the deviation without any treatment was tried before actual experiments were started. It was seen that in the 36 plots the deviation was $\pm$ 12 per cent in grain and $\pm$ 15 per cent in straw. This standardizing will be continued one more year before starting the experiment on differential seed-bed manuring.

(*c*) *Residual effect of molasses on paddy.*—The molasses experiment was continued in B block of the wet lands to test the residual effect of previous application of molasses. No fresh application was made this year and results are as follows :—

	Yield per acre.	
	Grain.	Straw.
	LB.	LB.
1. Control	2,503	3,910
2. 5 tons molasses	2,634	3,810
3. 7½ tons molasses	2,475	3,433
4. 4 tons molasses plus Ammonium sulphate	2,468	3,738

No residual effect was noticed, and the results are not significant.

(*d*) *Activated sludge plant effluent for paddy.*—This experiment was continued during the year in the A block using G.E.B. 24 as seed. It was noticed, however, that irrigation with effluent had an effect of killing tender seedlings at the early stage being apparently too " strong ", and hence the plots were irrigated with channel water till they established themselves and the effluent irrigation was then resumed.

The results of the harvest were as follows :—

Treatment.	Yield per acre.	
	Grain.	Straw.
	LB.	LB.
Channel water plots	3,088	3,081
Effluent plots	3,417	4,160

The results were statistically significant.

(*e*) *Sullage for paddy.*—The utilization of the large volume of raw sullage water from the College Estate was investigated by using it for paddy. This raw sullage contains a large quantity of manurial substances in solution, an average analysis is as follows :—

Ammonia	...	...	...	2·68 parts per 100,000
Nitrite ...	...	...	...	0·18 parts per 100,000
Nitrate ...	...	...	...	0·14 parts per 100,000

Sullage was applied to the field as irrigation diluted 1 : 3 with channel water. The results of the harvest were as follows, in the five replications.

	Yield per acre.	
	Grain.	Straw.
	LB.	LB.
Channel water plots	2,543	3,164
Sullage plots	3,433	3,932

The increased yield is significant.

Raw sullage can therefore be profitably used for paddy if diluted with channel water to the extent of 1 : 3.

12. *Animal Nutrition*—(i) *Maintenance requirements of working bullocks.*—The work on the requirements of bullocks for maintenance was continued during the year. The data previously obtained was confirmed and the requirements for maintenance was once again found to be 100 gms. digestible protein per 1,000 lb. live weight.

(ii) *Protein metabolism and muscular work.*—This new aspect of the work in which a correlation between the quantum of work and quantum of protein requirement was sought for was carried out during the year. The experimental bullocks were made to perform work for eight hours and six hours daily at the mhote, and the protein required at these two levels measured.

It was seen that the quantity of protein required during the eight hours and six hours mhoting periods was 500 gms. and 400 gms. respectively, these two quantities being in the same ratio to each other as in the hours of work, i.e., eight and six. It would seem likely that since the protein requirement rises with increased work, and since the quanta of work are in direct proportion to the quanta of protein requirement, the quantum of protein requirement is a linear function of the quantum of work. Such a relation has not till now been established elsewhere.

The tissue breakdown is therefore proportional to the work done and therefore requires replacement by additional quantities of protein, in proportion to the intensity of work done.

This work is being continued at a lower level of work, i.e., four hours to see whether the same proportionality exists.

(iii) *Sulphur metabolism of sheep.*—A detailed study was made of the metabolism of sulphur in sheep, with a view to correlate its possible influence on wool growth. Eight rams were divided into two groups, one group was fed 2·5 gms. elemental sulphur and the other was a control. Both groups received a concentrate ration of groundnut cake and wheat bran.

The results of metabolism experiments showed that the sheep receiving sulphur was able to metabolize elemental sulphur by retaining about 20 per cent of the total sulphur fed, the remainder of the sulphur being excreted as sulphate and organic sulphur in the urine. The Nitrogen metabolism of the group receiving sulphur was disturbed, indicating that the excreted sulphur was in the form of a nitrogenous compound.

Analysis of the wool showed no marked differences in its composition to indicate that sulphur had been stored in the wool. Nor was there any increase in fleece weight, or difference in its quality.

(iv) *Utilization of molasses as a cattle food.*—The problem of the utilization of molasses in feeding cattle were under investigation. It is well-known that though molasses is a palatable food,

containing a large quantity of sugar in its composition, it is not possible to feed it in any large quantities, to cattle. Previous experiments have shown that the maximum quantity that can be fed is about 2 lb. per head daily. Its sticky viscous nature makes it difficult to handle, and thus detracts from its value. Attempts were made to compound it with oil cake and cotton seed to make it into a solid capable of being easily handled, and at the same time to increase the nutritive value by mixing in a protein rich material, and to contain a sufficient quantity of minerals.

Two such types of cakes were made and their composition given in table below :—

TABLE.

Heads of analysis.	Cake I, containing 1 ounce of mineral mixture.		Cake II—No mineral supplement.	
	In the whole cake in gms.	Composition.	In the whole cake in gms.	Composition.
		PER CENT.		PER CENT.
Moisture	42	9·81	41	10·25
Ash	51	11·92	29	7·25
Fat	20	4·68	20	5·00
Crude proteins	128	29·90	125	31·25
Fibre	16	3·74	15	3·75
Carbohydrates	171	39·95	170	42·50
Calcium (CaO)	16	3·74	2·0	0·50
Phosphoric acid (P_2O_5) ..	7·6	1·78	4·2	1·05

These cakes made with molasses were called "Molascakes," were handy and kept well without getting mouldy or wet. Each cake is designed to supply 100 gms. of digestible protein, i.e., the maintenance diet of a bullock for a day when fed with roughage in addition.

Note.—Work done on Mineral Metabolism of Dairy stock mineral deficiency Pasture work, Poultry work, and Biological value of protein is separately reported on in a Report to the Imperial Council of Agricultural Research.

13. *Microbiology*—(i) *Studies on Azotobacter.*—The soils of the Central Farm, Coimbatore, were investigated in detail to obtain an efficient strain of *azotobacter.* An efficient strain was isolated from the New Permanent Manurial plots and used for the study.

Wheat was grown in pots and in the field (Field No. 19, Central Farm) with inoculation with a culture of Azotobacter. The increase in yield of plots grown with inoculated seed over control plots were significant.

(ii) *Keeping qualities of milk under household conditions.*—The keeping quality of milk under household conditions was studied. The usual practice of boiling milk after purchase is well known in South India. It was seen that this practice limits the growth of bacteria very considerably, and enhances the keeping quality. It was also seen that the termophillic bacteria plays a very insignificant part in the spoilage of milk.

14. *Agricultural Industries*—(i) *Active carbon—Bulk preparation.*—Active carbon was prepared in bulk as in previous years, a total of about 4,000 lb. was made.

This was distributed to Departmental Officers in the circles for Cream Jaggery demonstrations, and to private parties in small quantities as sample. A total of 3,079 lb. were so disposed off.

(ii) *Improvement in technique of manufacture.*—The method of making active carbon was modified slightly by carrying out the first carbonation outside the tube. Small heaps of paddy husk were made on a cement floor, and live charcoal introduced at several places on the heap. The paddy husk burnt slowly and the char was cooled and treated as before.

This made a saving in fuel costs and gave a very satisfactory final product. The cost of making carbon with this modification was about As. 1–3 per lb. as compared to As. 1–9 in the old process.

(iii) *Revivification of active carbon.*—With a view to reduce the cost of making cream jaggery, experiments were made to revivify active carbon used for filtration. It was found that strong heating of the used carbon in closed tubes, caused the carbon to be made active to the same degree as before and the process only cost As. 0–4 per lb. Active carbon can be revivified twice to four times.

(iv) *Jaggery making.*—Experiments on making jaggery with cane juices that develop a red colour on boiling showed that the coloration in the jaggery was due to soluble nitrogenous substances in the juice undergoing chemical change in the course of boiling. The addition of sodium hydrosulphate had the effect of preventing this effect.

(v) *Keeping quality of cream jaggery.*—Cream jaggery on storage turns brownish and thus loses its attractive cream colour. Experiments conducted in the laboratory showed that when kept in the air tight bottles in the presence of So_2 no change occurred in colour. This method is however not capable of practical application and other methods are being sought.

(vi) *Sugar making by the open pan process.*—The yield of sugar or rab was increased by about 10 per cent by keeping rab at a temperature of 60° for 4—5 hours, the rab being stirred every hour. By this method crystallization was induced at a higher temperature and at a slower rate. Another method was by the addition of molasses to the rab and treating the massicuite as before.

(vii) *Jaggery from palm juices.*—Investigations showed that it was possible to produce jaggery and sugar from palm juice free from the flavour of toddy by the use of active carbon.

15. *Cholam malting.*—Details are given in the report submitted to the Imperial Council of Agricultural Research.

P. V. RAMIAH,
Government Agricultural Chemist.

Agricultural Research Institute,
Lawley Road, P.O. Coimbatore,
31*st May* 1937.

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST, COIMBATORE, FOR 1936–37.

I

I beg to submit the following report on the activities of the Entomology section for the year ending 31st March 1937.

II. Charge.

I continued to be in charge of the section as Officiating Government Entomologist throughout the year.

III. Enquiries and Noteworthy Pests of the year.

During the year under report, 312 enquiries were received and attended to. Most of these related to insect pests of crops and their control and bee culture. There were also enquiries regarding Ericulture, insecticides and spraying and dusting appliances. The following are some of the more important crop pests which received attention :—

(1) The Mango stem borer (*Batocera rubus*, L.) from Vettaikaranpudur, Pollachi taluk.

(2) The Swarming caterpillar of paddy (*Spodoptera mauritia*, B.) from parts of Malabar, South Kanara and Hyderabad (Deccan).

(3) White ants on lemon and mango trees from Kallikote; on ganja from Nandyal and in buildings from Panyam.

(4) *Epilachna* on brinjals from parts of Coimbatore.

(5) The Sunnhemp caterpillar (*Utetheisa pulchella*, L.) from Pattukkottai and Trichinopoly.

(6) The Coconut caterpillar (*Nephantis serinopa*, M.) from Kothapeta, Guntur, Chittoor, Salem and Madura.

(7) *Jassids* on Bhendai from Coimbatore.

(8) Dermestid beetles (*Dermestes frischi*, Klug and *D. cadaverinus*, F.) damaging artificial silk from Madras.

(9) The Jasmine bug (*Antestia cruciata*, F.) from Coimbatore.

(10) The Pentatomid predator (*Andrallus*) on caterpillar pests of Daincha from Aduthurai.

(11) The Pomegranate butterfly (*Virachola isocrates*, F.) from Mettupalayam.

(12) The Coconut beetles (*Oryctes rhinoceros*, L. and *Rhynchophorous ferrugineus*, F.) from Mettupalayam and South Kanara.

(13) The Coreid bug (*Dasynus antennatus*) on citrus fruits from Kallar gardens.

(14) The Shoot webber (*Orthaga exvinacea*, M.) and the Castor slug (*Parasa lepida*, C.) on mango from Mettupalayam.

(15) The Rice bug (*Leptocorisa acuta*, Th.) from Kodumudi, Tinnevelly and Coimbatore.

(16) The Paddy root grub (*Echinocnemus oryzae*, M.) from Bhimavaram, Tadepalligudem and Tanuku.

(17) The Chillies thrips (*Scirtothrips dorsalis*, H.) from Tanjore.

(18) The Paddy ' Namavandu ' (*Tetroda histeroides*, F.) from Erode, Musiri and Namakkal.

(19) The Gram caterpillar (*Chloridea obsoleta*, F.) on tomatoes from Coimbatore.

(20) The Paddy thrips (*Thrips oryzae*, W.) from Coimbatore.

(21) The Cane borers from Villupuram and Coimbatore.

(22) The Hairy caterpillar (*Euproctis* sp.) on pomegranate from Coimbatore.

(23) Fruit sucking moths (*Ophideres* spp.) on citrus from Gudiyattam.

(24) *Laphygma exigua*, H. on tobacco seedlings from Chirala.

(25) The Paddy mealy bug (*Ripersia oryzae*, Gr.) from Tanuku.

(26) The Citrus leaf miner (*Phyllocnists citrella*, S.) from Bhimlipatam.

(27) The Castor capsule borer (*Dichocrocis punctiferalis*, G.) in cardamom pods from Kollengode.

(28) *Pulvinaria pasidii*, M. on chillies from Koilpatti.

(29) *Plusia orichalcea*, F. on lupins from Nanjanad.

(30) The Rice stem borer (*Schoenobius incertellus*, W.) from parts of Coimbatore.

(31) Ants attacking vegetables from Musiri.

(32) The Mango hopper (*Idiocerus* spp.) from Udamalpet.

(33) The Grape flea beetle (*Scelodonta strigicollis*, M.) from Krishnagiri.

(34) The Cotton leaf roller (*Sylepta derogata*, F.) from Mettupalayam.

(35) *Sitodrepa panicea*, L. on stored coriander seeds from Koilpatti.

(36) The Citrus butterfly (*Papilio demoleus*, L.) from Bezwada and Podanur.

(37) The Cotton stem weevil (*Pempheres Offinis*, F.) from Guntur.

(38) The Red hairy caterpillar (*Amsacta albistriga*, W.) from Dhone and Baroda.

(39) The Rice Chrysomelid (*Hispa armigera*, Ol.) from Hyderabad.

(40) The Paddy grasshopper (*Heiroglyphus banian*, Fb.) from Coimbatore and Palghat.

(41) The Moringa hairy caterpillar (*Eupterote mollifera*, W.) from Coimbatore.

(42) *Cosmophila* sp. on cotton from Karur.

(43) *Antigastra catalaunalis*, D. on gingelly from Tindivanam.

(44) The Neem scale (*Pulvinaria maxima*, Gr.) from Vellakkinar.

(45) The Turmeric beetle (*Lasioderma serricorne*, F.) from Cocanada.

(46) Aphis attack on different crops such as mango, Cephalandra, lotus, cholam, cotton, lablab, wheat, etc., from different parts.

(47) Leeches in ponds from Manjeri.

(48) Snails on paddy (*Viviparous variatus*) from Guntur.

(49) Mites on cholam from Musiri on groundnut from Palur, on jasmine from Coimbatore and on Soya beans from Aduthurai.

(50) Rat damage to tea bushes from Munnar, in granaries from Madura and to crops from Tindivanam.

IV. Special Investigations.

1. *Pests of sugarcane.*—Considerable progress was made in the study of sugarcane pests and their natural enemies. The moth borers and mealy bugs received special attention.

Scirpophaga.—Life history and general habits of the pest, symptoms and extent of damage, etc., were worked out in detail. A study of the incidence of the pest, under field conditions, has shown that it is not an insignificant pest as was once thought to be. Moths are found throughout the year. The pest attacks both young and grown up canes. The life cycle is about 54–79 days, the egg, larval and pupal periods being 7–8, 30–53 and 17–18 days respectively. The longevity of the adults is about 3–4 days.

Six different larval parasites have been noticed of which two—*Stenobracon nicevillei* and *Elasmus zehntneri*—were studied in detail. Possibilities of liberating these parasites are being investigated.

It has been stated that there are two species of *Scirpophaga* in South India—*S. monostigma* and *S. auriflua*. Our observations have indicated that there is only one species and both the spotted and spotless forms are got from the progeny of the same moth. Detailed studies are in progress.

Diatraea.—Studies on the incidence of the pest and the damage done to different varieties of cane received some attention. The egg parasite—*Trichogramma minutum*—is being investigated, both

under field and laboratory conditions in connexion with the biological control of the pest. Collection of eggmasses in the early stages of the crop and destruction of shoots showing dead hearts are also useful in reducing the pest.

The Cane mealy bug (*Ripersia sacchari*).—Life history studies of this pest have revealed that the life cycle is about 40 days. The egg period is very short. The nymphs hatched out in about 10 to 20 minutes. A species of brown ant has been noticed wherever the mealy bugs were present; perhaps, they give protection to the bugs. Dipping the cane setts in different solutions for controlling the pest is being tried. Of the three natural enemies of the mealy bug, namely—a lady bird, a fly and a chalcid—the latter appears to be the most effective.

2. *Pests of paddy—The Swarming caterpillar of paddy* (*Spodoptera mauritia*).—Investigations on the incidence of the pest were continued. The occurrence of the pest at Palghat, Coimbatore and Malabar was recorded this year also. Further observations on the egglaying habits of moths were made in the kole areas in the West Coast. Bulk rearing of the pest showed that during days of abnormally low humidity and high temperature there was great mortality among moths and eggs, and paucity in egglaying. The control methods tried against the pest included the use of sweeping baskets of Travancore pattern and dusting with Calcium arsenate in the nurseries.

The paddy stem borer (*Schoenobius incertellus*).—The incidence of the pest for several types of paddy at the Paddy breeding station was studied. The long duration varieties, planted early or late, showed varying degree of attack; even the shortest duration crop—a Japanese variety flowering in about a month after planting—was not immune to attack. There was no indication of any varietal resistance.

The study of the parasites of the pest showed that there was widespread occurrence of the parasite *Trichogramma* sp. and *Tetrastichus* sp. from December onwards. During March large numbers of the parasites were found dying within the eggs of the host. The data collected on the white ears and number of tillers from several plots were submitted to statistical analysis and the correlation was found to be negative.

The study of various grasses and other vegetation during the off-season was undertaken but no alternate food plant of the pest was noted.

Light trap trials of the previous year were continued in the Central Farm wet lands. The effect of the trap could be clearly seen inasmuch as the average infestation in the vicinity of the trap up to a distance of 350 yards was only 0·37 to 2·21 per cent whereas the average infestation outside this range varied from 2 to 7 per cent.

Seasonal studies of the fortnightly plantings in the Paddy breeding station was continued with the co-operation of the Paddy Specialist. These have shown that moths and eggmasses are found in large numbers during the period December to March.

The paddy grasshopper (Hieroglyphus banian).—A study was made of the incidence of the grasshopper in Palghat taluk during the year under review. The emergence of young hoppers began in the second week of June. They were found in large numbers in the months—August and September—after which they disappeared. Studies in the incidence of the pest showed 2 to 17 per cent infestation.

A parasitic nematode (*Mermis nigrescens*, Duj.) was found inside the body of certain grasshoppers. The hoppers which were affected by this worm were observed to be very sluggish.

Killing the small hoppers when they emerge from bunds; hand-netting them in the early stages; and bund scraping for destruction of eggs were demonstrated as remedies for the pest.

3. *Pests of fruit trees—Fruit flies.*—Collections of different fruits from different localities were made to note the species of fruit flies infesting them. In this way considerable data have been gathered. Six more species have been added to the previous list. The common species of wild Solanum in the Nilgiris has been identified as *Solanum auriculatum* and the flies breeding in these fruits as *Dacus ferrugineus dorsails.* The results of the studies on their seasonal incidence showed that the flies are found breeding in Solanum fruits throughout the year. The parasites are rare from January to May; from June to October their numbers increase. In July as many as 993 parasites have been collected from 2,000 fruits. This is the highest ever recorded. The flies infesting mangoes, guavas, etc., in the Nilgiris are being studied to find out whether *dorsalis* is the dominant species. The following parasites of the fruit flies have been collected :—

Larval parasites—

1. *Opius (Biosteres) longicaudatus,* Ash.
2. *Opius incisi,* Silv.
3. *Opius persulcatus,* Silv.

Pupal parasites—

1. *Spalangia philippinensis,* Full.
2. *Dirhinus auratus,* Ash.

In the Central Farm orchard Clensel was tried as a lure. *Dacus cucurbitae* and *Dacus correctus* were attracted.

Dasynus antennatus.—This bug belonging to family Coreidae was found to do damage to tender shoots and fruits of oranges at Kallar (Nilgiris). As a result of the attack the fruits began to get yellow and fall off in numbers. Both adults and nymphs were found to puncture fruits. During the next season this pest will be studied in detail.

Perina nuda.—Life history and habits of this pest of figs were studied during the year. The moth takes about 4 to 5 weeks to complete its life cycle. One larval parasite—*Megarhogas* (a new species) and a pupal parasite—*Goryphus nursei*—have been collected from the field. The former is prevalent from October to January.

Virachola isocrates.—This Lycaenid pest of pomegranates received some attention during the year. An examination of a large number of unopened buds, opened flowers and young and old fruits showed that in not a single instance were the eggs laid in the buds and flowers. Eggs are normally found in the calyx cups of young and old fruits. The whole life cycle of the butterfly takes about a month. Control methods such as removal of calyx cups, spraying with Lead Arsenate, etc., are being tried.

Helopeltis antonii.—This capsid bug is found to do considerable damage to tender shoots, leaves and fruits of guava trees in the orchard. Damage is done by the adults and nypmhs. As a result of their attack greyish black spots are seen in the affected portions which later on fade and dry up. The pest is controlled by spraying with crude oil emulsion and Bordeaux mixture.

4. *Pests of Coconut—The Rhinoceros beetle*.—Considerable progress was made in the study of this serious pest on coconut palms. The investigations included the seasonal incidence, life history study and field and laboratory conditions, observations on the habits of the adults and control measures.

Weekly collections of beetles from infested trees have disclosed the activity of the adults throughout the year. These were found most active from February to April. The life cycle of the pest under field conditions came to 4 to 5½ months, the egg, larval and pupal periods being 7–16 days, 3–4½ months and 22–30 days respectively. A few of the reared beetles lived up to 7 months. Two beetles laid 115 and 122 eggs respectively and the latter is still alive. Eggs are always found inside clods in the manure heap. Of the various materials tried for feeding the adults, sugarcane stem was found to be the best.

Control measures such as destruction of the beetles by hooked wires, trials of the parasitic green muscardine fungus received from Ceylon, etc., are under trial. Baits of different kinds, viz., sweetened mash of groundnut cake, gingelly oil cake, neem cake, and coconut cake were tried as attractants with negative results.

5. *Pests of Cotton—Bollworms* (*Platyedra and Earias*).—During the year, Cambodia cotton bolls were examined for bollworms in the Central Farm, Cotton breeding station and the special tracts in the Anamalais. The Pink and Spotted bollworms infestations in March-April were as follows—Central Farm 32·4 per cent and 3·3 per cent; Cotton station 52 per cent and 4·5 per cent; and Anamalais 9 per cent and 2 per cent. The first two were irrigated crops while the third was rainfed.

The Cotton scale (*Saissetia nigrum*).—This scale insect is sometimes found in large numbers on the cotton plants and in severe cases of attack the plants are liable to be killed. The pest is often found on a variety of hosts including Portia. To note whether Portia trees served as centres of infestation two trees were selected of which one was given a severe pruning and sprayed with lime sulphur and the other kept as control. The condition of the scales on the Portia trees and cotton plants round these trees was noted month by month. The final counts showed that only 6·1 per cent of the cotton plants near the sprayed tree were affected while 51 per cent near the control suffered badly.

The percentage of parasitisation of the scales by the chalcid—*Scutellista cyanea*—was also studied during the year. The incidence of the parasites was high in the months of November and December when about 60 per cent of the scales were found parasitised.

6. *Pests of Tobacco—Laphygma exigua.*—Caterpillars of this moth noted for the first time as a pest of tobacco nurseries in South India occurred in large numbers at Chirala. Investigations on the pest have shown that the insect breeds throughout the year on a sand dune weed—*Gisekia pharnaceoides*. Two Tachinid parasites *Sturmia inconspicuoides* and *Actia monticola* and the Reduvid bug —*Rhinocoris fuscipes*—were noted as natural enemies and observations were made on the habits and life histories of these. Dusting of Calcium arsenate gave satisfactory results against the pest.

7. *Pests of Chillies—The Chillies thrips* (*Scirtothrips dorsalis*, H.).—This is one of the most important pests of chillies. Preliminary investigations during the year have shown that dusting with flowers of sulphur is effective against the pest. Even though the dust has no ovicidal properties yet the nymphs which emerge succumb within 12–24 hours. A week after dusting, the plants are found to be free from these insects. During the coming season experiments will be conducted to work out the comparative cost of the sulphur and tobacco treatments.

8. *Pests of Cholam—The Cholam earhead bug* (*Calocoris angustatus*).—Experiments for the control of this serious pest of cholam were started in May in the summer crop (Chitrai cholam). The object of the experiments was to find out if insecticidal treatment would give economical control of the bug. Tobacco decoction, tobacco dust and flowers of sulphur were tried as control measures and of these, the last was found to have toxic effect on the nymphs as well as adults. The experiments were continued in the rainfed crop (Periamanjal). Sulphur alone was used in this case as it gave promise last season. This time the object of the experiment was to find out the number of dustings necessary and the stage of growth of the crop when dusting has to be done. Unfortunately, owing to continued interference of weather, the experiments could not be carried out as originally planned. Pest incidence on the whole

was lighter than that of the previous crop. The yields of the plots were not significant. The experiments will be repeated in the coming crop when the economics of the treatment will be worked out in detail.

Freckled yellow and stripe diseases of cholam.—Incidence counts taken in one of the Central Farm fields showed 24·8 per cent and 1·7 per cent infestation of freckled yellows and stripes respectively. The incidence of the yellows was high towards the bunds and low towards the centre of the field. It has been definitely proved that the adults and nymphs of the cholam shoot bug—*Peregrinus maidis* (*Pundaluoya simplicia*) are able to transmit the freckled yellow disease. Other suctorial insects like *Aphis sacchari* and *Aphis maidis* were not successful in transmitting the disease. All the three gave negative results for the stripe disease.

9. *Pests of Cabbage—The Diamond back moth* of cabbage (*Plutella maculipennis*).—Studies on this pest were continued. Derris dust has been found to be effective against the pest. Two wasps, one parasitic on caterpillars and the other on pupae were observed in numbers during the season and their habits and life histories studied in detail.

10. *Pests of Moringa—Noorda.*—Studies on the leaf and bud caterpillar pests of moringa were continued. Both these caterpillars were previously identified as *Noorda blitealis.* The results of our studies have clearly shown that the two are different species and the latter is now being described as a new species by Mr. Tams of the Imperial Institute of Entomology, London. Spraying of Calcium arsenate has been found to be effective against these leaf caterpillars while Bordeaux mixture acted as a repellent in the case of the bud moths.

Two other pests of moringa—*Eupterote mollifera* and *Stictodiplosis moringae* received attention during the year. Due to the habit of clustering on tree trunks during day time spraying of kerosene was found effective against the former. The later—an Itonidid found inside flower buds—has been noted for the first time in South India and is under study.

11. *Pests of Castor—Tetranychus telarins.*—Generally speaking, insects are the most important pests of castor. But this year the castor crop in the Central Farm had a serious attack of the mite—*Tetranychus telarius.* The mite belongs to the family Tetranychidae. Both young and old plants were affected by this pest. Preliminary studies have indicated that the mite takes less than a fortnight to complete its life cycle and that there are a number of generations in the year. Spraying with lime sulphur has been found to be very effective against the pest.

12. *Pests of Stored Products.*—The study of the pests of stored products was continued. Observations with different varieties of paddy seeds kindly supplied by the Paddy Specialist have indicated

that GEB. 24, A.1, A.3, A.5 and M.5 show varying degree of resistance to the paddy borer attack, the puttoos (red and white) being highly susceptible.

Laboratory tests with the cholam seeds As. 29 and As. 1,575 and As. 367 and As. 809 kindly supplied by the Millets Specialist have shown that the last two varieties are more susceptible to the grain weevil attack than the first two. Experiments to see if storing of cholam seeds with chemical powders such as Sodium fluosilicate, Borax, Calcium sulphate, Copper carbonate, etc., is effective in preventing the weevil attack are in progress.

13. *Pests of Daincha—Semiothisa pervolgata.*—Caterpillars of this moth were found in a pest form on Daincha in the Central Farm and the Paddy breeding station, Coimbatore. This is the first time that a Geometrid is noted doing serious damage to crops in South India. Light traps have been found successful in attracting the moths. Braconid parasites—*Apanteles sp.* found in large numbers in the later stages have been able to check the pest considerably.

14. *Insecticidal trials.*—During the year, the following insecticides received from different firms were under trial : Cymag, Tree Tanglefoot, Fish oil rosin soap (Techno), Derris dust, Hillo, Tanglefoot spray, Dactine, Plantinsecto, Clensel, Pyrethrum, H.G. Ionised insecticide, Keep Green, Cocksec and Dry Pyrocide. Decoctions of horsegram and lablab husk were tried against aphis on pomegranate and orange respectively, the former was not quite satisfactory but the latter gave encouraging results. Spraying the manure heap in the fly maggot traps with gingelly oil cake solution (3 oz. of cake soaked overnight in one gallon of water) was found to make the trap more attractive to houseflies.

V. Life History Studies and Pest Control Work at Headquarters.

The more important of the economic insects whose life histories were studied at the Insectary in charge of the Assistant Entomologist, Mr. T. V. Subramaniam, are given below :—

1. The Coconut beetle—*Oryctes rhinoceros.*
2. *Semiothisa* on Daincha.
3. The Guava capsid—*Helopeltis.*
4. *Dasynus antennatus* on oranges.
5. *Grammodes stolida* on Daincha.
6. *Dacus brevistylus* on Coccinia.
7. *Anoplolepis longipes* found predaceous on *Oecophylla.*
8. *Rhinocoris fuscipes* (Reduvid) on *Laphygma* caterpillar.
9. *Eupterote* and *Stictodiplosis moringae, Noorda bliteals* and a new caterpillar pest on *Moringa pterygosperma.*
10. *Ripersia sacchari* on sugarcane.
11. *Scirpophaga* and its parasites—*Stenobracon nicevillei* and *Elasmus zehntneri.*

12. *Achroea grisella*—the lesser wax moth.
13. A Braconid parasite of *Galleria*.
14. *Saissetia nigrum* on cotton and Portia.
15. *Laphygma* on tobacco.

Numerous insect pests found in the Central Farm and breeding stations received attention during the year. These included *Epilachna* on brinjals; *Utetheisa* on Sunnhemp; *Noorda* and *Eupterote* on moringa; aphis on cholam, brinjals, bhendai, orange, tomatoes cabbages, cowpea, lablab and tobacco; scales on mango, lucerne, sapota, orange and plantains; thrips on chillies, groundnut and paddy; fruit flies and *Aulacophora* beetles on cucumber; fruit sucking moths on orange; mites on Bhendai; *Aprorema* on Soya beans and groundnut; Thiacidas on Ber and Bruchids on Bengalgram.

VI. Beekeeping and Ericulture.

Work in connexion with beekeeping showed considerable progress. On an average about 40 bee colonies were maintained at the Insectary and out apiaries in different parts of the Central Farm and in the Millets breeding station. During the year under review, generally speaking, the pasturage and weather conditions were not quite satisfactory. On account of the failure of the usual thunder showers in April and May the condition of the colonies was not up to the mark at the beginning of the year itself. The south-west monsoon during June and July was again disappointing. The dry conditions followed by the windy weather during the latter part of July and first half of August further retarded the progress of the colonies. A few welcome showers towards the second fortnight of August and during the subsequent months of September, October and November stimulated the activities of the bees. Most of the colonies regained their original strength and some of them even developed the swarming impulse during November. There was again a long spell of dry weather during December, January, February and first half of March which again acted as a set back on the progress of the colonies. The belated showers during the third week of March relieved the situation to some extent.

Research.—Research on various aspects of beekeeping was continued. The bee enemies and their control received some attention during the year. The wax moth (*Galleria melonella*) was studied in detail. Life history studies of a braconid parasite of the pest are in progress. The lesser wax moth of Europe—*Achroea grisella*—was for the first time noted in South India and considerable information was gathered on this pest. The life-cycle of the moth is about 17–19 days of which the egg, larval and pupal periods are 2–4 days, 10 days and 5 days respectively. The maximum longevity of the moth is about 18 days and the maximum number of eggs laid in captivity 185. A wasp—*Palarus orientails*—for the first time noted on the West Coast was studied in detail and its interesting habits and remedial measures have been included in a paper entitled " A new enemy of the Indian honey bee " published in the Madras Agricultural Journal. Swarm control experiments tried included Snelgrove,

Peck's and dequeening methods. The results obtained have to be confirmed by further trials next year. The bee pasturage plants also received some attention. Two more plants, viz., *Prosopis juliflora*, D.C. and *Citharexylum subserratum* have been added to the list already noted. A plant—*Stereospermum suaveolus*—said to be a good nectar yielder was obtained from Bangalore and planted in the Insectary orchard for study.

Propaganda.—Propaganda in beekeeping was done both by the Entomological and District staff. Demonstrations in hiving wild colonies, care and management of apiaries, etc., were given in different parts of the Presidency. Bee colonies and apicultural appliances were sent to different shows and exhibitions and these attracted numerous visitors. During the year, the following apicultural requisites were distributed by the section : Extractors 42; empty hives 15; hives with bees 4; and smoker 1. The above do not represent the actual number distributed throughout the Presidency since many of the circle officers are making their own arrangements to meet the needs of the ryots. Attempts made to send queens by post have been successful. As the departmental bulletin on beekeeping is out of print a revised edition has been prepared and is in the press. A Tamil translation will also be out very soon. As these two are priced publications a small pamphlet on " Practical hints on Beekeeping " has been prepared for free distribution to the ryots.

Training in Beekeeping.—The usual short course in beekeeping was held in February. Twenty-five students in all from various parts of the Presidency attended the course. They were given a thorough training, especially in the practical aspects of beekeeping. During the year under review, the Government deputed 27 departmental officers for special training in beekeeping of which 5 were entomological assistants, 22 agricultural demonstrators, and the remaining 1 a demonstration maistri. They were given training both in the theoretical and practical aspects of this industry in two batches—one in January and the other in March. It is hoped that those who received training will do their best to popularise this subsidiary industry and help the ryots to enhance their scanty earnings from Agriculture.

Ericulture.—Eri worms were reared throughout the year for supplying eggs to rearers in different parts of the Presidency.

VII. Fumigation and Pest-free Certificates.

During the year, 58 lots including samples of seeds, live plants, etc., were received from different parties and examined for pests and fumigated when necessary. These included—

(1) Millets for despatch to Holland, Australia, Burma, Germany, Nyasaland, British Somaliland and Russia, and those received here for trials from Rhodesia, Sudan, Burma, Russia, Kenya, Canada, Gold Coast and Columbia.

(2) Oil seeds for despatch to South Africa, Ceylon, Nigeria, Uganda, and London and those received here for trials from Washington, South Africa, Japan, Tanganyika and Uganda.

(3) Cotton seeds for despatch to Brazil, Bombay, London and those received from Bombay and South Africa.

(4) Paddy seeds for despatch to Rangoon, Philippines, London, Italy, Russia and China.

(5) Coffee seeds from Java.

(6) Cucurbitaceous seeds to Sydney.

(7) Senna seeds to Russia.

(8) Soya beans to Philippines.

(9) Potatoes to Scotland.

(10) Linseed to Argentine Republic.

(11) Mango seedlings to Ceylon.

Some time was also spent in examining and passing seed canes for the Government (of India) Sugarcane Expert.

In addition to this, the laboratories of the Cotton and Millets breeding stations infested with store pests were fumigated.

VIII. Systematic Studies and Collections.

Systematic work was done by members of the staff in their special groups as time permitted. Specimens of Acarina affecting different crops were collected for study. Some work was done on Psyllidae, Aphididae, Braconidae, Chalcidae, Ichneumonidae and Sphecidae.

During the year under review, several consignments of insects were sent to the Imperial Institute of Entomology, London; Bureau of Entomology, Washington; Professor Drake of Iowa; Lesne of Paris Museum; and the Director, Zoological Survey, Calcutta for identification, to all of whom the thanks of the section are due.

In addition to this, small lots of insects were identified for correspondents from different places. A few specimens of *Stomatocera ayyari* and *Leucospids* were sent to Mr. M. S. Mani, Indian Museum, Calcutta for study and specimens of *Opius persulcatus*, *Dirhinus*, *Spalangia* and a few Rhynchota were sent to the Imperial Entomologist, New Delhi, for his collections.

Once again, I have to emphasize the need for the revival of the post of the Systematic Assistant Entomologist to be in charge of our valuable collections and for systematic studies of various economic groups of insects.

IX. Entomological Work in the Districts.

The Entomological Assistants in the circles attended to numerous enquiries on pest control received from time to time and also carried out investigations of crop pests peculiar to their localities as time permitted. They took part in various exhibitions and conducted demonstrations in pest control methods. They were also in charge of the Pest Act operations.

The more important pests which received attention in the I Circle were the Red hairy caterpillar of cumbu and groundnut; the swarming caterpillar of paddy, root grubs, grasshoppers and stem

borer pests of paddy; the Coconut caterpillar; the Chillies thrips; Brinjal Epilachna; Aphis and Prodenia on tobacco. Besides these, a good deal of propaganda work was done on beekeeping.

In the II Circle, the Entomological Assistant demonstrated remedial measures against chillies thrips and made observations on the cholam shoot bug and snails affecting paddy. He also attended to reports on Nephantis on palmyras, Spodoptera on paddy, Epilachna on brinjals, grasshoppers and Prodenia on tobacco and Papillo on citrus.

The major pests which received the attention of the Entomological Assistant, III Circle, were the Zizyphus fruit fly, fruit sucking moth, Laphygma on lucerne, Pyrilla on cane, thrips on onions and the Rhinoceros beetle.

In the IV Circle, the major pests tackled were Nephantis on coconuts, Amsacta on dry crops, mango hoppers and Epilachna on brinjals. Demonstrations in beekeeping were given in different localities. The Entomological Demonstrator was also in charge of the hairy caterpillar campaign.

The Entomological Assistant in the V Circle attended to the following pests :—Paddy stem borer, the striped bug—*Tetroda*, the rice caseworm, the sugarcane fly and the borers, lablab aphis, mites and *Stomopteryx* on soya beans, epilachna on brinjals and agathi stem borer and the sunnhemp moth. Sometime was also spent in popularising beekeeping.

The important pests tackled by the Entomological Assistant in the VI Circle were the chillies thrips, thrips on chrysantheemums, the pomegranate borer, aphis on citrus, the coconut beetles and the mango hoppers.

In the VII Circle, there were outbreaks of the swarming caterpillar and caseworm of paddy and the coconut caterpillar which were attended to by the Entomological Assistant. Detailed observations were made on the pepper flea beetle and rhinoceros beetle.

During the year under review, I visited most of the circles and was able to see something of the good work being done by the Entomological Assistants in close co-operation with the Agricultural Demonstrators.

X. Scientific Papers prepared and published.

A. The following papers were prepared and published during the year under report :—

(1) " Notes on the incidence of the swarming caterpillar of paddy " by M. C. Cherian and K. P. Anantanarayanan, published in the Madras Agricultural Journal, Volume XXV (2).

(2) " Fruit sucking moths on tomatoes and their control " by M. C. Cherian and C. V. Sundaram, published in the Madras Agricultural Journal, Volume XXIV (10).

(3) " Research and propaganda work in beekeeping " by M. C. Cherian and S. Ramachandran, published in the Madras Agricultural Journal, Volume XXIV (9).

(4) " A new enemy of the Indian honey bee " by M. C. Cherian and V. Mahadevan, published in the Madras Agricultural Journal, Volume XXV (3).

B. The following papers were prepared during the year and are awaiting publication :—

(1) " Preliminary studies on the freckled yellow and stripe disease of cholam " by M. C. Cherian and M. S. Kylasam, Proceedings of the Association of Economic Biologists, Coimbatore.

(2) " White moth borer of sugarcane (*Scirpophaga*) in South India " by M. C. Cherian and C. K. Subrahmaniyam.

(3) " Studies on *Laphygma exigua* and its natural enemies " by M. C. Cherian and M. S. Kylasam.

(4) " Studies on *Stenobracon nicevillei*, Bingh, a parasite of the sugarcane white moth borer " by M. C. Cherian and and P. Israel.

(5) " *Elasmus zehntneri*—a parasite of the sugarcane white moth borer (*Scirpophaga*) " by M. C. Cherian and P. Israel.

(6) " Notes or the life history and habits of *Dacus brevistylus* (*f. Trypetidæ*)— a pest of Coccinia Indica fruits " by M. C. Cherian and C. V. Sundaram.

(7) " Notes on two parasites of the diamond back moth of cabbage in South India " by M. C. Cherian and Mohamed Basheer.

(8) " A Geometrid caterpillar pest of Daincha " by M. C. Cherian and B. Rangiah Pillai.

(9) "Notes on Grammodes stolida " by M. C. Cherian and C. V. Sundaram.

(10) " Notes on the life history and habits of *Oncocephala tuberculata* " by M. C. Cherian and N. Krishna Menon.

Of the papers mentioned above, numbers 1 and 4 in A and 4 and 6 in B were presented at the Agricultural section of the Indian Science Congress held at Hyderabad in January 1937.

In addition to these, various other items such as leaflets, articles for the villagers' calendar, a history of the work done by the section for Sir John Russell, a short account of work done on sugarcane pests for the sugarcane Entomologist, New Delhi, a summary of the work of the section up to 1930 for the Imperial Entomologist, etc., were prepared and submitted.

XI. Miscellaneous.

1. *Exhibitions and shows.*—Show cases of insects, lantern slides, coloured plates, bromide posters, beekeeping appliances, etc., were sent to the following exhibitions and shows during the year :—

(i) Health Week Exhibition, Ootacamund.

(ii) Agricultural Exhibition, Avanashi.

(iii) Cattle and Pony Show, Tiruppur.

(iv) Swadeshi, Industrial and Agricultural Exhibition, Tinnevelly.

(v) Agricultural and Industrial Exhibition, Srivilliputtur.

(vi) Exhibition at the Maharaja's College, Trivandrum.

(vii) Health and Baby Week Exhibition, Tiruchengode.

(viii) Park Fair Exhibition, Madras.

(ix) Agricultural and Industrial Exhibition, Srirangam and Palghat.

(x) Exhibition at Kallipatti, Tiruchengode.

(xi) Health Week Exhibition, Coimbatore.

(xii) Exhibition at Ahobilom, Nandyal.

In addition to these, an elaborate show depicting the various activities of the section was put up at the exhibition in connexion with the Diamond Jubilee of the Madras Agricultural Students' Union.

Show cases received from district officers for renewal of insect specimens were attended to as far as possible.

2. *Artists' section.*—The Artists' section continued to be under my charge throughout the year under report. The following items of work were done in the section :—Paintings 482; pen and ink drawings 377; labels 435; photographs 969; prints 4,256; slides 154; and enlargements 141.

Whenever possible, artists were sent to the circles for help in connexion with the exhibitions staged by the officers concerned.

3. *Special lectures.*—At the request of the Principal, a lecture on " Mite Pests of Crops in South India and their control " was delivered for the B.Sc.Ag. students.

4. *Supply of live parasites.*—A consignment of fruit fly parasites was sent to Mr. Gurney, Entomologist, New South Wales. Mr. Hadden, Entomologist, U. S. Bureau of Entomology, who was given facilities to work in the Insectary, took with him a consignment of fruit fly parasites to Hawaii.

5. *Research Council.*—I attended the two meetings of the Council in June 1936 to discuss the sixth half-yearly report and in February 1937 to discuss the programme of research work for 1937–38.

6. *Entomological meeting at New Delhi.*—As permitted by the Government, I attended a meeting of the Entomologists convened by the Imperial Council of Agricultural Research in January 1937 to discuss the work done on sugarcane pests and the appointment of special staff for the provinces and States.

M. C. CHERIAN,
Officiating Government Entomologist.

AGRICULTURAL RESEARCH INSTITUTE,
LAWLEY ROAD, P.O., COIMBATORE,
5th May 1937.

ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE YEAR 1936–37.

I beg to submit the following report of the work of the Mycological section during the year ending 31st March 1937.

Charge.—M.R.Ry. Rao Bahadur S. Sundararaman Avargal, M.A., I.A.S., was in charge of the section till the 7th November 1936, on which date he retired from service. He was connected with the section from its very inception and has played a great part in the development of the section from its small beginnings to its present magnitude. I took charge of the section on his retirement so that the greater portion of the period under report falls within my predecessor's term of office.

The activities of the section may be classified under the following main heads, viz., (1) Mycological research, (2) Virus research, (3) Miscellaneous investigations, (4) Propaganda and disease control campaigns and (5) Advisory work.

(1) Mycological Research.

The following is a brief account of the research work on mycological problems in progress during the year. As usual, special attention was devoted to diseases of economic importance.

1. *Paddy.—Foot-rot (Fusarium moniliforme).*—A field experiment was laid out to study the effect of nitrogen, potash, phosphoric acid and their various permutations and combinations on the incidence of the disease. All the plots received a basal dressing of farmyard manure. The different manurial treatments tried were as follows :—

(1) N (ammonium sulphate) 20 lb. N per acre.
(2) P (super phosphate) 10 lb. P_2O_5 per acre.
(3) K (potassium sulphate 15 lb. K_2O per acre.
(4) N+P.
(5) N+K.
(6) P+K.
(7) N+P+K.
(8) Farmyard manure ($2\frac{1}{2}$ tons per acre).
(9) Control (Basal dressing of farmyard manure).
(10) No manure.

The plots were randomized and each treatment replicated eight times. Artificially infected seed was sown. The results are furnished in Table I. From the summary of the statistical analysis (Table II) it is clear that the plots which received nitrogen either alone or in combination with other manurial ingredients show significantly higher incidence of disease than the control and the plots which did not receive nitrogen.

TABLE I.

Foot-rot of paddy—Mean percentage of disease in experimental plots.

Treatment.	Percentage of dead plants in the different weeks. (Average of eight replications).										Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
N	12·8	14·4	9·9	2·7	1·1	0·4	0·4	0·2	0·1	..	42·0
P	7·3	12·4	7·3	1·3	0·8	0·2	0·2	0·3	0·1	..	29·9
K	6·4	12·5	6·9	1·4	0·4	0·2	0·4	0·1	0·05	..	28·4
N + P ..	11·4	13·4	9·2	3·1	1·0	0·7	0·6	0·2	0·1	..	39·7
N + K ..	14·3	15·8	9·6	2·1	1·1	0·5	0·5	0·1	0·2	..	44·2
P + K ..	9·2	14·8	8·5	1·5	0·7	0·3	0·3	0·1	0·1	..	35·5
N + P + K ..	12·8	13·3	9·6	2·9	1·0	0·9	0·3	0·1	0·1	..	41·0
Farm yard manure.	8·7	14·4	8·2	1·5	0·6	0·2	0·4	0·1	0·1	..	34·2
Control ..	6·0	11·4	7·1	1·6	0·4	0·1	0·1	..	..	..	26·7
No manure ..	4·9	9·6	7·5	1·6	0·4	0·4	0·2	..	0·1	..	24·7

TABLE II.

Summary of analysis—Mean death as percentage on the control.

Control.	N	P.	K.	N + P.	N + K.	P + K.	N + P + K.	F. Y. M.	No manure.	Standard error.	Critical difference.
100 ..	159·8	111·8	106·5	149·0	164·4	130·4	151·9	127·2	91·11	1·46	3·76

Laboratory studies were made with a view to determine whether this higher incidence of disease could be explained as due to the direct effect of the manurial ingredients on the growth of the fungus. A basic medium was prepared from soil extract and calculated quantities of salts yielding N, K and P were added to equal portions of the medium. The various media were plated out and the linear rate of growth of the fungus studied.

TABLE III.

Rate of growth of F. moniliforme in soil extract media to which various salts are added.

Medium.	pH of the medium.	Growth of the fungal colonies on plates on different days (in m.m.)								Average growth per day (m.m.)
		4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	
Monocalcium phosphate.	6·01	3·5	7 2	11·1	14·8	17·9	21·8	26·1	30·2	3·8
	6·01	3·3	6·9	10·8	14·6	17·5	20·9	24 0	29·5	3·7
Magnesium phosphate.	6·27	3·6	7·8	11·7	15·4	18·6	22·4	26·0	30·5	3·8
	6·27	3·6	7·4	11·2	14·6	17·9	21·7	25·7	29·9	3·7
Sodium phosphate.	6·52	3·6	7·5	11·3	15·1	18·3	22·3	29·4	30·5	3·8
	7·20	3·3	6·9	10·7	14·2	17·6	21·8	25·4	29·3	3·7
Potassium chloride.	5·84	4·0	8·2	12·3	16·0	19·2	23·6	27·8	32·5	4·1
	6·86	3·8	8·1	12·3	16·1	20·2	24·6	29·3	33·7	4·2
Potassium acetate.	6·18	4·6	9·2	13·6	17·6	21·1	25·4	29·4	33·4	4·2
	6·01	4·4	9·2	13·8	17·6	21 9	25·4	29·2	32·5	4·1
Asparagin ..	6·52	4·0	8 3	13·2	17·3	21·5	25·5	30·3	35·9	4·5
Urea ..	6·27	4·0	7·8	12·6	17·1	21·0	25·0	29·2	32·6	4·1
	6·69	3 7	7·2	11·4	15·5	18·7	22·1	25·1	28·2	3·5
Ammonium sulphate.	6·69	4·8	9·4	14·1	19·1	23·6	28·6	33·3	37·1	4·6
	6·35	5·5	10·7	15·7	21·0	26·1	30·9	36·0	40·2	5·0
Control (Soil extract agar).	6·35	3·9	8·5	12·5	16·1	19·1	21·3	23·9	27·3	3·4

The results (Table III) show that there is a pronounced increase in the rate of growth in media containing ammonium sulphate and asparagin but not in urea. *F. moniliforme* being a fungus which enters the seedling before it begins to draw nutriment from the soil, the evidence available goes to show that the increased

incidence of disease is due to the better growth of the fungus in a nitrogen-yielding medium. So long as the fungus is effectively controlled by seed-dressings like Ceresan, the experimental results do not warrant any modification in the cultural practices, as a means of control.

2. *Paddy blast*—(*Piricularia oryzae*).—Cases of heavy infection of the variety G.E.B. 24, which is highly resistant to the disease in the plains, were recently recorded from hilly tracts like Wynaad and Coorg. This raises the issue whether varieties which are resistant under one set of climatic conditions would remain resistant under different conditions. With a view to study these aspects of the problem, cultures of the fungus were obtained from representative tracts on the hills and the plains. The problem of Piricularia control in the plains still centres round the utilization of varietal resistance. It is gratifying to note that the paddy specialist, Coimbatore, has evolved three strains of G.E.B. 24 × *Korangu samba* crosses which are highly resistant to Piricularia and at the same time yield 10 to 18 per cent more than the original *Korangu samba* stock.

3. *Areca palm*—*'Mahali' or 'Koleroga'* (*Phytophthora arecae*—The disease of areca palms has been the subject of extensive research about thirty years ago by Dr. Coleman in Mysore. The Madras Department of Agriculture has also done considerable work on this fungus especially in relation to its parasitism on coconut. Both the departments have for long been engaged in popularising spraying as the surest means of control. The mixture originally recommended is 2 per cent Bordeaux mixture (10–10–50) with rosin (4 lb. per 50 gallons) as an adhesive. In recent years, however, new adhesives and spreaders like casein and vegetable oils are coming into favour among a section of the areca growers chiefly because of the simplicity in their manipulation. Though some attempts were made in recent years to reduce the strength of the mixture and to study the relative merits of the new adhesives, satisfactory results could not be obtained chiefly because of the great variation in the intensity of the disease from year to year. The problem of the minimum strength of the mixture compatible with safety and the suitability of the different adhesives from the view point of efficiency and cost, still remains unsolved. Again, some aspects of fundamental research into the life cycle of the fungus such as the method of 'over wintering', longevity, optimum temperature and humidity, etc., need elucidation. A study of the foregoing problems has been started. As a result, it has been observed that the resting conidia of the fungus remain viable in the soil of infected gardens. Studies made so far go to show that the fungus is incapable of growth and multiplication in the soil though the resting conidia that shed into the soil germinate freely when the optimum moisture is supplied. The study of the flight of resting conidia with the aid of aeroscopes has shown that the condia could be trapped at a height of 32 feet above the ground

level during the dry months. Germinated condia produce abundant mycelium but not zoospores. When the fungus is grown in a liquid medium of initial pH. 4·3, it was observed to change the pH. to 3·7 in the space of a fortnight. Further studies are now in progress.

TABLE IV.

The effect of the growth of P. arecae on the reaction of the medium.

(Initial pH. of solution before inoculation : 4·32.)

Serial number.	Date of readings.								
	4th March 1937.	6th March 1937.	8th March 1937.	10th March 1937.	12th March 1937.	15th March 1937.	17th March 1937.	19th March 1937.	22nd March 1937.
1	4·15	3·90	3·90	3·98	3·98	3·98	3·90	3·90	3·81
2	3·81	3·90	3·90	3·98	3·98	3·90	3·85	3·90	3·81
3	4·07	3·98	3·90	3·98	3·98	3·90	3·85	3·81	3·81
4	3·64	4·07	3·90	3·90	3·98	3·98	3·81	3·81	3·77
5	4·07	3·98	3·90	3·90	3·90	3·90	3·85	3·85	3·72
6	3·90	3·98	3·81	3·90	3·98	3·90	3·81	3·81	3·81
7	3·90	4·15	4·07	3·98	3·98	3·90	3·90	3·85	3·81
8	3·90	3·90	3·73	3·90	3·90	3·90	3·81	3·77	3·81
9	3·90	3·98	3·81	3·90	3·90	3·98	3·81	3·81	3·81
10	3·98	4·15	3·81	3·98	3·98	3·98	3·90	3·90	3·81

4. *Areca—' Die back ' of flower bunches—Gloeosporium sp.*— For the first time, another disease of the areca bunches was observed during the year. This is characterised by the ' die back ' of the flowering bunches and the shedding of female flowers between December and February. Our knowledge of the botany of the areca palm and the seasonal factors in relation to nut production are still imperfect and it is therefore impossible to say whether fungus troubles other than Mahali prevent the production of nuts all the year round. It is a common observation that flower bunches are produced from leaf axils at the rate of about one a month, but even in irrigated gardens those which are formed between February and May alone produce nuts. The inflorescences formed one to two months prior to this period were found to die back and shed the female flowers. A Gloeosporium was isolated from the dead and dying portions of flower stalks and the fungus was proved by inoculation experiments to be parasitic on tender areca and coconut inflorescences. The exact role which this fungus plays in the failure of flower bunches to set nuts is now under investigation.

5. *Tobacco ' Black shank '—(Phytophthora nicotianae).*—The study of the ' black shank ' disease of tobacco was continued. Previous work done in this section has shown that burning the surface of nursery beds and periodical spraying of the transplant crop produce less disease individually and in combination. A more elaborate field experiment was laid out this year in two fields in Salem district where the disease was prevalent in previous seasons. The

following individual treatments and combinations of one or more treatments were tried :

(1) Seed treatment with silver nitrate.
(2) Burning trash on the surface of seed beds.
(3) Sowing the seed in raised beds.
(4) Spraying of seedlings in the nursery.
(5) Raciborski's method of soil treatment (ammonium sulphate + lime) and
(6) Periodical spraying of the transplant crop.

Plot-war records of deaths of plants are being taken and the final results are awaited.

Cultural studies of the fungus were made to determine its systematic place. Production of sporangia was sparse in oat meal and French bean agars, but profuse when the mycelium is transferred to sterile tap water. The sporangia varied from 26·5 to 66·5μ in length and 17·5 to 35μ in breadth. The following results were obtained from inoculation experiments :

TABLE V.

Plant inoculated.	Nature of inoculation.	Result on inoculated tissue.	Control.
Solanum tuberosum.	2 wounded tubers ..	—	—
Do.	2 unwounded tubers ..	—	—
Lycopersicum esculentum.	2 wounded ripe fruits ..	+	—
Do.	2 unwounded ripe fruits.	—	—
Solanum melongena.	2 wounded unripe fruits.	+	—
Do.	2 unwounded unripe fruits.	+	—
Areca catechu ..	2 wounded nuts ..	—	—
Do.	2 unwounded nuts ..	—	—
Theobroma cacao ..	2 wounded pods ..	+ after 8 days	—
Do.	2 unwounded pods ..	Do.	—

6. *Macrophomina phaseoli.*—The work on this fungus was continued. The fungus was recorded on a new host, viz., coriander.

A series of pot experiments were done with the strain isolated from horsegram to determine the incidence of wilting in relation to the age of the host plant. The following is the summary of results :

TABLE VI.

Wilting caused by *M. phaseoli* in relation to age of plants.

Total number of plants.	Percentage of deaths in the				Total percentage of deaths.
	First week.	Second week.	Third and fourth weeks.	Fifth a sixth weeks.	
89	14·6	21·4	10	Nil.	46·0

The figures show that about 35 per cent of the plants died within the first fortnight as against 10 per cent in the second fortnight and nil in the third.

In another experiment where horsegram and French bean seedlings were used as hosts, it was found that French beans were more susceptible to the horsegram strain than horsegram itself as the following results prove.

TABLE VII.

Pathogenicity of the horsegram strain on horsegram and French bean.

Serial number and host.	Total number of plants.	Number of wilted plants.	Percentage of infection.
1. Horse gram	63	27	43
2. French bean	41	41	100

Similar results were obtained when seeds of horsegram and French beans were sown in tubes containing infected soil. Out of 24 French bean seeds 20 failed to germinate and developed the fungus on them, while only five out of 24 horsegram seeds failed to germinate.

Pycnidial formation in culture.—The formation of the pycnidial stage which was hitherto considered a rare phenomenon was frequently observed in plates of quaker oats agar, glucose agar, malt-extract agar and French bean agar.

Change in pH. of medium.—A preliminary study was made of the change in the reaction of the medium caused by the fungus. Richard's solution of initial pH. 3·8 in which the fungus was grown was found to have a pH. value varying from 5·58 to 5·88 at the end of a fortnight.

7. *Redgram and cotton wilt* (*Fusarium vasinfectum*).—A comparative study was started with two strains of *F. vasinfectum* recently isolated from redgram and cotton. Both were grown in Richard's solution of initial pH. 3·8. After a fortnight the cotton strain was observed to have made a better growth and caused a shift in the pH. from 3·8 to 6·24 while the redgram strain made a scantier growth and the pH. changed to 4·95. This is apparently an indication that the two strains are physiologically different. Further studies are being made on these strains.

8. *Bananas—Wilt* (*Fusarium cubense*).—Mention has been made in previous reports of the occurrence of the Panama disease of bananas in parts of South India. Varietal trials have shown that two varieties were particularly susceptible, viz., *Rasthali* a table variety and *Mondan* a variety whose fruits are popular as a green vegetable. During the year a third variety *Vallai* which is grown on the hill slopes of the lower Palnis as a perennial crop was found infected. The field symptoms were identical with those observed in the plains. The fungus responsible was brought into pure culture and found identical with *F. cubense* (form iv—*Oxysporum*).

A field experiment was conducted to see whether the treatment of rhizomes with mineral oils would kill the affected rhizomes and serve as a means of control. Two kinds of oils were tried, viz.,

(1) ' Malariol ' and (2) ' B Liquid fuel '. The minimum dose required to kill an affected stool was three pints of oil which works out at Re. 0–5–6 for Malariol and Re. 0–2–6 for B liquid fuel. Under Indian conditions, it is not economical to eradicate diseased stools with so expensive a treatment. Fortunately, the bulk of the area under bananas in South India is cultivated on a rotation in which bananas occupy the land for three years only. In infected land the maiden crop is free from disease and the percentage of disease in the first ratoon is negligibly small. The disease assumes vigor in the second ratoon which is ordinarily a leaf crop after which the land is brought under paddy or sugarcane. With this system of rotation and the culture of several resistant varieties, the disease is not likely to assume serious economic importance.

9. *Sclerospora diseases of Cereals.*—The study of these diseases was continued. Though several attempts made to study the germination of oospores ended in failure, soil inoculation experiments showed that the fungus could be transmitted to seedlings from the soil. The best results were obtained when oospore material was ground up and placed in holes made in wet soil and the seed sown in holes. Inoculation experiments done in this manner showed that the sorghum strain of the fungus can infect sorghum and maize seedlings but not cumbu (*P. typhoideum*) and Italian millet (*S. italica*). The phenomenon of leaf shredding was invariably found in sorghum but extremely rare in maize. Infected leaves of maize produce conidia when placed in a very humid atmosphere. Diseased material from the Italian millet failed to infect sorghum, maize and *cumbu*. Similarly diseased material from *cumbu* failed to infect sorghum, maize and Italian millet. It is therefore evident that at least three specialised strains of the fungus exist, viz., the sorghum strain which infects sorghum and maize, the *cumbu* strain which infects only *cumbu* and the *tenai* strain which infects only *tenai*.

10. *Cereal Rust Investigations.*—One of the assistants engaged for ' Cereal Rust Investigations ' under the research scheme of the Imperial Council of Agricultural Research, continued to work at Coimbatore. He was engaged in carrying out the survey of wheat rust in the wheat areas of the hills and plains of South India. The following are the salient points of his work :—

Survey.—In the Nilgiri and Palni hills which are about 6,000 feet above sea level, two wheat crops are raised the first roughly between June and September and the second between October and January. Between the end of the second season and the beginning of the first (February to March) some tillers and self-sown plants are found in various stages of growth in moist fields, vicinity of thrashing floors and village rubbish heaps. These were found infected producing uredospores and serving as sources of infection to the June crop. But the June (first) crop is not seriously affected by rust probably due to the comparatively sparse sources of inoculum and the heavy monsoon winds prevailing at that time. As the

monsoon subsides, infection rapidly increases and the second (October) crop is heavily infected. Wheat is grown during the same period (October–January) in the plains and rust appears in the plains when there is heavy infection in the hills. In the Shevaroy hills (4,000–5,000 feet) there is only one wheat crop and rust does not appear till December. As the crop in the plains gets rust earlier than December, the crop in the Shevaroys does not appear to function as a source of infection in the plains.

Flight of spores.—For the study of dissemination of rust spores in the plains, aeroscopes were set up in parts of Coimbatore and the exposed slides periodically despatched to Dr. Mehta at Agra.

Period of infection (Brown rust).—Monthly sowings were done at Coimbatore to determine the earliest period of infection. Brown rust was first observed last season at Coimbatore on the 16th November which is one month earlier than the period of first observation in 1935. The highest intensity was observed between 25th December 1936 and 24th January 1937. The intensity was over 1,600 against a possible maximum of 2,000 (United States Department of Agriculture scale).

Comparison of susceptibility of Agra wheat and local wheat.—A variety of wheat from Agra reputed to be very highly susceptible was sown side by side with local wheat. Rust appeared eight days earlier on local wheat though the Agra variety was hemmed in by an infected wheat crop on all sides. Inoculation experiments in the pot culture house confirmed this observation. Comparative studies in the increase in extent and intensity also showed that the increase was more rapid in local wheat.

Incidence of other physiologic races of wheat rust in the plains.—Black rust was first noticed on Pusa 4 variety of wheat on February 18th. In the previous year no black rust was recorded.

Puccinia graminis tritici was also noticed on March 18th on Agra wheat and on some rogue plants of barley. But no black rust was observed on the local wheat.

Puccinia glumarum was not observed at any time.

11. *Physiology of Parasitism of fungi.*—A small piece of fundamental research was done to study the relative roles of the enzyme pectinase and oxalic acid in the parasitism of fungi. The fungi chosen for study were *Botrytis cinerea*, *Sclerotinia sclerotiorum* and *Sclerotium Rolfsii*, the last mentioned being a widely distributed tropical fungus occurring on a variety of hosts in India. A comparative study showed that all the three fungi produce the cell-wall-dissolving enzyme Pectinase, but the enzyme of each showed marked specific differences in that the optimum range of pH. for their activity varied widely. The study of the production of oxalic acid by the fungi showed that on the same medium *S. Rolfsii* produced the largest amount (up to 2 per cent on potato plugs); *S. sclerotiorum* produced relatively smaller amounts and *B. cinerea* only a trace. The amount of oxalic acid produced decreased with the

increased acidity of the medium. A similar phenomenon was observed when *S. Rolfsii* was grown on living tissues and tissue extracts. All the fungi produced ammonia. Confining the study to *S. Rolfsii*, the optimum pH. for the action of its enzyme was found to be provided by the oxalic acid it produces. When the acid was eliminated the enzyme was rendered inactive, but activity was restored by providing the requisite pH. by the addition of any acid. Pure oxalic acid in proportions found in the crude enzyme extracts is capable of making ½ m.m. thick potato discs limp within a period of 10 to 15 minutes and tearing the discs from 16 to 48 hours. That highly dissociable acids and acid salts can also produce this phenomenon, suggests that it is the H ion concentration that produces the action. Pectinase of *S. Rolfsii* can produce the tearing even at a higher pH. (pH. 3) in the short space of 30 minutes—a proof that the enzyme is of far greater importance in dissolving the cell walls than oxalic acid produced by the fungus. The above work was done at the Imperial College of Science, London, under the direction of Professor W. Brown in whose laboratory I worked for a year on study leave.

(2) Virus Diseases.

1. *Sugarcane—Mosaic—(a) Varietal resistance experiments.*—The annual field trials to estimate the relative resistance of cane varieties to ' mosaic ' were continued. Seventeen varieties were included in the trial. The first signs of secondary infection were noticed 33 days after planting. The percentage of infection in the check variety (Co. 213) was 70 as against 63·5 last season and 95·0 during the two previous seasons. The progress of infection was most rapid during May, the third month after planting. A consolidated statement showing the varieties tested during the last four seasons and the percentages of secondary infection recorded is given in Table VIII.

Table VIII.

Sugarcane Mosaic—Varietal resistance trials 1933–34 to 1936–37.

Serial number and varieties tested.	Number of years under trial.	Percentage of infection.			
		1933–34.	1934–35.	1935–36.	1936–37.
1 Co. 205 (Pusa). ..	4	Nil.	Nil.	Nil.	Nil.
2 Co. 213	4	95·0	95·0	63·5	70·0
3 Co. 335	4	Nil.	Nil.	Nil.	Nil.
4 Co. 360	4	73·0	81·5	55·4	56·0
5 Co. 361	4	70·0	55·5	53·4	40·0
6 P.O.J. 2878 ..	4	Nil.	Nil.	Nil.	Nil.
7 Co. 363	3	39·0	17·0	11·4	..
8 Co. 355	3	..	Nil.	Nil.	Nil.
9 Co. 402	3	7·5	13·0	13·4	..
10 Co. 408	3	31·0	13·5	37·5	..
11 Co. 412	3	8·5	10·5	7·2	..
12 Co. 205	2	Nil.	Nil.	..	..
13 Co. 354	2	..	55·0	55·0	..

Serial number and varieties tested.	Number of years under trial.	Percentage of infection.			
		1933–34.	1934–35.	1935–36.	1936–37.
14 Co. 411	2	..	4·0	1·9	..
15 Co. 413	2	..	4·0	Nil.	..
16 Co. 417	2	..	49·0	43·5	..
17 Co. 419	2	..	43·0	43·6	..
18 Co. 353	2	..	..	5·4	Nil.
19 B. 3412	1	70·0	..	..	..
20 E.K. 28	1	85·5	..	..	..
21 Poovan	1	62·5	..	..	..
22 Vellai	1	79·5	..	..	..
23 Co. 229 ..	1	..	..	Nil.	..
24 Co. 313	1	..	..	63·4	..
25 Co. 326	1	..	..	Nil.	..
26 Co. 331	1	..	..	38.0	..
27 Co. 356	1	..	..	Nil.	..
28 Co 421	1	..	..	24·3	..
29 Co. 426	1	..	..	43·1	..
30 Co. 429	1	..	..	39·9	..
31 Co. 508	1	..	..	Nil.	..
32 Pundia	1	..	..	25·6	..
33 Co. 352	1	..	..	..	Nil.
34 Co. 407	1	..	..	..	8·0
35 Co. 416	1	..	..	..	62·0
36 Co. 422	1	..	..	..	Nil.
37 Co. 423	1	..	..	..	70·0
38 Co. 432	1	..	..	..	18·0
39 Co. 434	1	..	..	..	Nil.
40 Co. 438	1	..	..	..	23·0
41 Uba	1	..	..	..	Nil.

(*b*) *Inoculation trials on resistant varieties.*—In order to see whether the freedom of certain varieties from the disease was a case of real resistance or merely a case of disease-escape, the central spindle of five plants of each of the varieties Co. 205, Co. 335, Co. 352, Co. 353, Co. 355, Co. 422, Co. 434, Uba and P.O.J. 2878 were inoculated with the mosaic virus by the pin-prick method; but none of the plants developed the disease. It may be recalled that one plant of Co. 205 and one of Co. 355 developed the disease when similar inoculations were done on a previous occasion.

(*c*) *Masking.*—The phenomenon of ' masking ' noticed two years ago in the varieties Co. 360 and Co. 361 received further attention. It was found that in individual plants of Co. 361, the symptoms completely disappeared after some time and even after the canes were cut, the ratoon shoots failed to show leaf-mottling. Similarly seedlings raised from sets of such plants did not develop mosaic symptoms and pin-prick inoculations from such plants to a highly susceptible variety like Co. 213 did not induce infection. It is presumed that the virus in the ' masked ' plants gets attenuated and loses its infective power.

(*d*) *Insect transmission trials.*—Repeated trials made with *Pyrella sp., Phenice moesta and Aphis sacchari* to transmit the disease from infected to healthy canes gave negative results.

2. *Redgram mosaic.*—A new disease of redgram characterized by the following symptoms was observed in Coimbatore :—

(1) Mottling of leaves.

(2) Stunting of the plants and diminution in the size of leaves.

(3) Failure of infected plants to flower.

The two latter symptoms are confined to advanced cases of infection when the appearance of the plant is not unlike that of a spiked sandal tree. It was noticed that nearly 10 per cent of the plants in a field were affected so that the loss due to the disease is not insignificant. Mechanical inoculations with the extracted sap of diseased leaves gave negative results. But insect transmission trials with a jassid of the redgram (*Empoasca sp.*) previously fed for 24 to 48 hours on infected leaves gave two cases of success on redgram plants. Similar trials done with *Aphis medicagenes* and two species of thrips were not successful.

3. *Virus diseases of Potato.*—Potato cultivation has made rapid strides in recent years in the Nilgiri hills. The present area is about 12,860 acres. The most popular variety among ryots is ' Great Scott ' which is fairly resistant to virus diseases. At the Potato Research Station, Nanjanad, however, several suspected cases of virus trouble were found on a wide range of varieties. Preliminary experiments were done to see if the disease symptoms were transmissible. Plants raised from tubers collected from plants suspected of (1) simple mosaic, (2) calico mosaic and (3) crinkle reproduced the respective symptoms. Sap inoculation of a mosaic found on the variety *Arran Banner* gave positive results on *Nicotiana glutinosa* and tobacco, giving a systemic infection twelve days after inoculation. Inoculations on tomatoes, however, failed. Further attempts to classify the diseases and to determine their host range are now in progress.

4. *Sorghum—Yellowing.*—Inoculation experiments repeated during the year have definitely proved that the virus of yellowing disease of sorghum is not sap-transmissible and that the insect vector *Pundalaya simplicia* is solely responsible for its spread. Intracellular bodies were absent in microtome sections of the leaf material, but the cells were disorganized and reduced in size in the diseased leaves.

(3) Miscellaneous Investigations.

1. *Fungicides, adhesives and spreaders.*—A field experiment was conducted on grape-vines at Michaelpatti to find out the relative merits of different vegetable oils as spreaders and incidentally to test the efficacy of a proprietary preparation called Longiceptol. Three sprayings were given at intervals. The efficacy of the mixtures was measured in terms of the index of mildew infection of bunches, giving category values 1, 2 and 3 for light, medium and heavy infections respectively. The results are given in Table IX.

TABLE IX.

Effect of different mixtures on mildew of grapes.

Serial number and treatment.	Percentage of light infection.	Percentage of medium infection.	Percentage of heavy infection.	Index of infection.
1 One per cent Bordeaux mixture + 0·5 per cent neem oil	24·8	4·3	..	33·4
2 One per cent Bordeaux mixture + resin	19·5	11·2	..	41·9
3 One per cent Bordeaux mixture + 0·5 per cent coconut oil	20·9	5·0	..	30·9
4 One per cent Bordeaux mixture + 0·5 per cent groundnut oil ..	15·4	3·3	..	22·0
5 Longiceptol ½ lb. per two gallons ..	5·1	13 0	13·4	71·3
6 Control	20·4	11·1	9·3	70·5

The only conclusion that could be drawn from this experiment is that Longiceptol is not a satisfactory fungicide.

Some preliminary experiments were done to see whether rosin boiled in soda solution could be preserved for some weeks so that the laborious boiling needed for its preparation could be done in advance of the actual use of the adhesive. It was found that the solution so prepared would keep for several days, but a warming up was necessary before use. A clear solution of rosin could be obtained if caustic soda is used in place of soda ash. Owing to the difficulty of handling caustic soda, it would be desirable if a ready-made preparation, preferably in the form of cakes in paper wrappings, is placed on the market. I have placed the problem before the Superintendent of the Kerala Soap Institute who has promised to investigate its possibilities.

2. *A new orange disease.*—A citrus disease characterized by the abnormal size of fruits, very thick and spongy peel with a pitted surface, low acidity and low sugar contents, a hollow core and an insipid taste, was found in some gardens at Kodur in Cuddapah district. Diseased and normal fruits were borne on the same tree and often on the same branches. There were no external or internal symptoms of injury of a parasitic origin. Analysis of the normal and diseased fruits gave the following results :—

TABLE X.

Heads of analysis.	Pulp of healthy fruit (small sized).	Pulp of diseased fruit (big sized).
1 Reducing sugars (per cent)	2·93	2·24
2 Sucrose (per cent)	5·74	3·84
3 Total acidity in 100 grams of pulp expressed as number of ccs. of N/10 KOH	59·1 cc.	39·5 cc.
4 pH value (Quinhydrone electrode) ..	4·26	4·50

	GMS.		GMS.
Weight of half of the healthy fruit	156·3	Weight of half of the diseased fruit	403·9
Weight of rind	40·6	Weight of rind	126·1
Weight of pulp	115·7	Weight of pulp	277·8

Descriptions and photographs were sent to Dr. Fawcett of the Citrus Experiment Station, Riverside, California, and Dr. Reichert of the Citrus Experiment Station. Tel-Aviv, Palestine, for their expert opinion.

3. *Cytology of economic plants.*—Dr. P. J. Gregory, who was awarded a fellowship of the Madras University, joined in September and started a cytological investigation of South Indian plants especially those of economic importance. The subjects of his study include the following plants :—

Soy beans, mango, tobacco, cotton, Bengal-gram, *Indigofera tinctoria, Carica papaya, Guazuma tomentosa,* jute, *Anona squamosa, Sesamum indicum, Asparagus officinalis, Ricinus communis, Santalum album, Sapindus emarginatus, Tradescantia sp, Psidium guyava* and *Achras sapota.* During the year over 500 slides were prepared and several interesting features were noticed from their examination.

(4) Propaganda and Campaigns.

1. *Areca—' Mahali ' or ' Koleroga ' (Phytophthora arecae).*— After several years of comparative lull, the disease appeared in South Kanara in a very virulent form at a time when the majority of areca growers were unprepared to combat its depredations. The result was that those who did not carry out spraying sustained heavy losses, in some cases amounting to total loss of the crop. There was a wide awakening in the district over the catastrophe and though it was too late in the season to obtain the maximum benefit from spraying, there was a rush for the purchase of sprayers and chemicals available in the market. The stockists of sprayers could not cope with the demand and anything which was sold under the name of sprayers was purchased, in many cases at fancy prices. The department did every thing possible to rescue the growers from their plight. All available sprayers were rushed to South Kanara and though the number so available was but a fraction of the immediate requirements, several ryots were enabled to save a portion of their crop. A very large section of areca growers were unable to obtain sprayers either for love or money and had to resign themselves to their fate. While the disease has caused a general calamity in the district, it has brought in its train some benefits also. Firstly it has done more educative propaganda and demonstration service among areca growers than any departmental agency can hope to do in the space of three or four normal seasons. It has taught such of those growers who were aware of the remedy but looked on it with apathy or suspicion, a lesson which they cannot forget for several years to come. In fact, there has been mass conversions to the spraying creed so that it gave an opportunity for the department to step into the breach and to study afresh the problems of areca growers. Again, the catastrophe had the effect of rousing areca growers to a sense of self-help. A co-operative society styled the Puttur Division Mahali Prevention Society has been formed

with headquarters at Puttur and has started work with a share capital of about Rs. 2,500. The society is planning to supply sprayers and chemicals to its share-holders in the taluks of Puttur and Kasaragod. From the departmental point of view, it gave us an opportunity to take stock of our past work and to feel that there is still room for improvement in our methods of tackling such a situation. The total number of sprayers (about 800) was found entirely inadequate for the 18,000 acres in the district under areca palms. It showed us once again that we have to make allowance for common human frailties, to appreciate the limitations of very poor ryots in making an investment on spraying equipment and to think of ways and means of catering to the needs of this class of people. So long as sprayers are not manufactured in sufficient numbers in this country, there is the need for encouraging extra-departmental agencies to supply them at reasonable prices and to supplement such sources by departmental organizations. The Deputy Director of Agriculture, Tellicherry, and myself have bestowed much attention to this matter and a promising start has been made to cater to the needs of the small growers by giving them *takavi* loans for the purchase of sprayers and selling sprayers to them at cost price. Importers of sprayers were approached by us and persuaded to keep sufficient stocks during the next spraying season. Two firms of manufacturers were advised about effecting certain improvements in the types of sprayers they were supplying. The Puttur Division Mahali Prevention Society was given technical advice on the subject of sprayers and for purchasing chemicals at the lowest market rates. A consignment of 85 sprayers was purchased by the Deputy Director of Agriculture, Tellicherry, for sale on deferred payments and for hiring out to deserving ryots. In G.O. Ms. No. 2265, dated 12th December 1936, Government were pleased to sanction a temporary staff of two upper subordinates and ten fieldmen for propaganda in the affected areas and thanks to the awakening caused by the happenings last year, it was possible for this staff to start work among people who were in a receptive mood.

2. *Palmyra bud-rot.*—The Pest Act relating to the bud-rot of palmyra and coconut palms in Palghat, Ponnani and Walluvanad taluks of Malabar district continued to be in operation throughout the year. Two agricultural subordinates and one Special Revenue Inspector were on special duty on this work. The progress of the operations could be guaged from the following table :—

TABLE XI.

Number of diseased palmyra trees cut between 1933–34 and 1936–37.

1933–34.	1934–35.	1935–36.	1936–37.
10,800	6,900	6,400	4,114

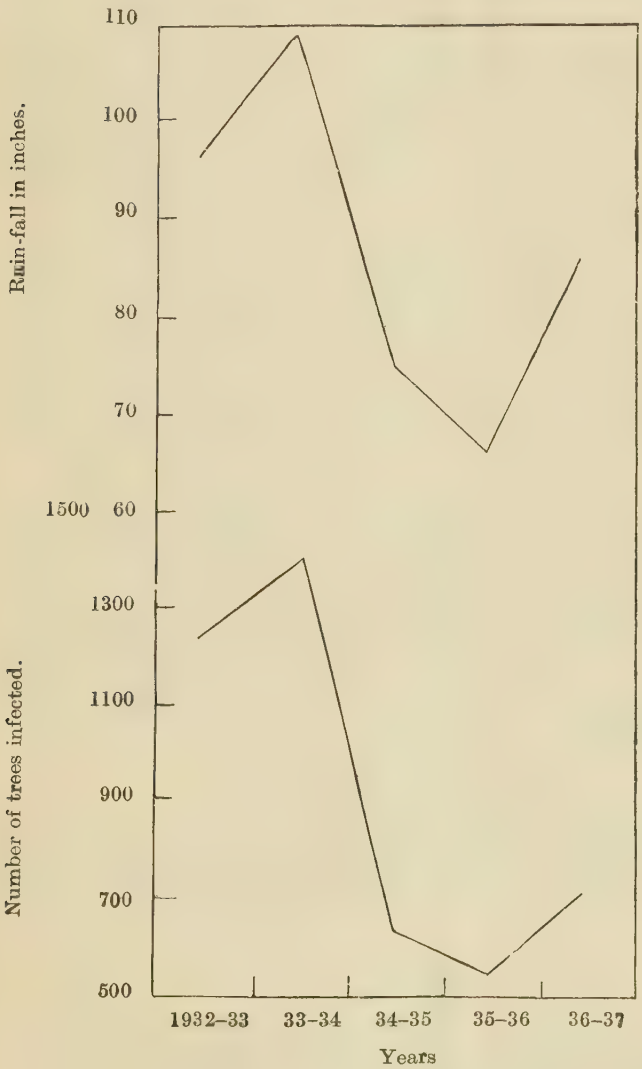
The number of fresh infections in Palghat taluk which contains the bulk of palmyra palms in the three taluks put together shows a very high correlation with the rain-fall (vide Table XII and graph).

Table XII.

Relation of amount of rain-fall to fresh infections.

Year.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Rain-fall in inches	96·52	109·09	75·27	66·25	86·55
Number of fresh infections ..	1,250	1,410	615	545	705

Correlation of rainfall to fresh infection 0·945.



Graph showing correlation of rain-fall to fresh infection

From the above table it is clear that the number of fresh infections has decreased considerably since 1933–34. There are two factors at work which contribute to fresh infections. They are (1) rain-fall and (2) sources of infection in the form of standing dead trees. The former is uncontrollable but the latter is. Any measure of control should therefore aim at the prompt destruction of dead trees and the efforts of the department are centred round this fact. But in actual practice, there is an inordinate delay between the detection of diseased trees and their removal. Intensive propaganda work was done by the departmental subordinates and the Special Revenue Inspector to bring home this fact to the ryots but the response has not been adequate. It has been found necessary to enforce the Act and serve notices to garden owners before they could be persuaded to cut their dead trees. We have to acknowledge the co-operation of the District Collector and the Sub-Collector, Palghat, in this work. The Sub-Collector has introduced a system by which his village subordinates have to submit a comprehensive monthly return showing the name of garden owners, survey number, number of dead trees standing, number of trees cut, etc., and this is serving a very useful purpose in locating cases of infection. But at present the burden of verifying these statements rests with the Special Revenue Inspector and the Agricultural staff and hence there is an inevitable delay in serving notices. I have been in touch with the Sub-Collector, Palghat, discussing the problem and enlisting his co-operation to accelerate the machinery of action.

3. *Exhibitions and Shows.*—In order to popularize the simple methods of disease control, the section participated in nine exhibitions held in different parts of the province. Explanatory charts, coloured illustrations and specimens of disease were put on show and demonstrations done at these exhibitions in order to draw the attention of the public to the importance of preventive and curative methods of control. Illustrations, charts and preserved specimens were supplied to district officers for purposes of exhibition at the departmental depots.

(5) Advisory Work.

Forty-eight specimens of diseased plants were received for examination in the laboratory and advice given to the parties by post. Besides these, several calls on the services of the staff were responded to.

Routine.

1. *Microtome section.*—This sub-section continued to be in charge of the Mycologist and was rendering useful service to members of the Research Institute and a few others for their microtome work. Five hundred and seventy-one samples were received, 531 materials embedded and 1,521 slides prepared in the microtome laboratory. The lower subordinate working in the laboratory prepared

153 blocks and prepared 319 slides besides supplying the requirements of the various workers in the matter of apparatus, chemicals, reagents, fixing fluids, stains, etc. The following list furnishes details of work done :—

TABLE XIII.

Officer.	Number of materials received.	Number of materials embedded.	Number of slides prepared.
Paddy Specialist	119	98	443
Oil seeds Specialist	93	97	405
Cotton Specialist	28	10	57
Millets Specialist	169	140	63
Government Mycologist	43	41	45
Government Agricultural Chemist ..	32	21	75
Veterinary Assistant	2	2	4
Lecturing Botanist	1	1	..
Dr. P. J. Gregory	84	121	383
Mr. V. Prabhaker Rao	..	..	46
Total ..	571	531	1,521

2. *Fumigation of seeds and plants.*—126 samples of seeds meant for despatch to foreign countries were fumigated during the year and certificates issued.

3. *Selection of planting material.*—Sugarcanes meant for despatch to various parts of India and to foreign countries were selected and certified regarding freedom from disease.

4. *Stock cultures.*—A start was made from 32 cultures supplied by Professor W. Brown of the Imperial College, London, to maintain a collection of type cultures of fungi as an aid to systematic study and research. About thirty additions were made since. New types are being added from time to time as they become available. At the request of the Imperial Mycologist, New Delhi, 59 cultures were supplied to him.

5. *Special lecture.*—I delivered a special lecture on " Virus diseases of plants " to the students of the Agricultural College.

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7th May 1937.

Sundararaman.

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